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NO GUNS AND NO BUTTER?

by
KAZIMIERZ W. TARCHALSKI *

Not long ago [1] Dr. Frank Knopfelmacher of Melbourne opinionated that the reforms in the Soviet Union and Eastern Europe may not bring the expected results. He questioned the established wisdom which claims the existence of a trade-off between military expenditure and expenditure for peaceful ends. Cuts in military budgets of the Soviet type economies, whether unilateral or negotiated, would not, according to Knopfelmacher's doctrine, bring more non-military goods such as: food, clothing, shelter, motor vehicles etc., etc. Fewer guns will not give way to more butter.

Let us discuss this issue. Under the conditions of scarcity, the trade-off between more of X and more of Y is one of the most important, if not the most important, general theorem of economics. Dr. Knopfelmacher does not seem to have referred to its general aspects. He referred rather to the situation in which there is a crucial change in the way the system functions, notably, a shift from the allocation by quantitative targets or quotas (called central planning) to the allocation by the intermediation of the market price. In other words, Knopfelmacher's doctrine refers only to the reforming Soviet type economies on the way from the plan to the market.

The doctrine implies that the success of the operation of "unscrambling eggs" that is – an attempt at making producers and suppliers responsive to changes in price rather than to changes in commands is uncertain. Producers and suppliers may not be sufficiently sensitive to changes in the new vehicle of information i.e. to prices. Or, using a bit of economic jargon, the price elasticity of supply may be too low. Thus, a successful transition to the market system would have to be associated with a hefty rise in the responsiveness of supply to changes in prices.

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* Canberra (Australia).

[1] During a conference devoted to the prospects of ethnic self-determination in the USSR held in Melbourne in June 1988.

Let us note that a rising price elasticity of supply allows not only for a faster rise in the production of the goods whose prices have risen, but also for a more rapid fall in the production of the goods whose prices have fallen. In the latter case, the volume of unsold inventories would be reduced, thus diminishing the inflated official growth figures for national income of centrally planned economies.

Now, let us devote some space to the major factors determining the elasticities of supply. The knowledge of these factors allows us to better understand the flaws of the current stage of reforms and thus to volunteer a better advice to overcome them.

First, the long run reaction of supply to changes in prices will be affected by *the expectation of the irreversibile and sustainable character of the reform process* in the USSR and Eastern Europe encapsulated by the slogan of "perestroyka". A high probability attached to the possible reversal of the political and ideological "perestroyka" would translate into a lack of confidence in the continuation of reforms in that part of the world and thus would negatively affect the sensitivity of the reaction by suppliers to changes in prices. The considerable pessimism of many observers of the Soviet politics as to the sustainability of the current economic reforms in the USSR makes for the reduction in the perceived price elasticity of supply.

Second, a positive factor boosting producers' sensitivity to price signals is a liberal, pro-market ideology, or at least, *the lack of an anti-market, or pro-nationalisation propaganda*. Active propagation of socialism, and in particular, its more vituperative variety is a sure way for lowering the sensitivity of reaction to price signals.

Third, an important factor that raises the responsiveness of reaction to price signals is a successful legal revolution that would create or reactivate *individual property rights in the dormant factors of production* such as: human and non-human capital and land, including the right to transfer, contract and transact these rights.

Fourth, the granting of *freedom to transact in goods and factors* of production implies the granting of freedom to enter into and to exit from any legitimate business or activity. In other words, price elasticities of supply are raised, if individual property rights in goods or factors are not replaced by individual property rights in values, positions or outcomes. To this end the removal of legal monopolies or monopsonies and a massive deregulation play a crucial role. The abolition of such entrenched forms of regulation as: quantitative restrictions, quotas, targeting of output or factors, discriminating taxation, "planning" of imports and exports, in short: the dismantling of "central planning", would attenuate individual property

rights in the ends of production, without attenuating individual property rights in the means of production. Property rights would again guarantee free access to and use over things but not over values!

Freedom to transact is also enhanced by *an improvement in industrial relations*. Such an improvement would weaken any collective property rights to outcomes, without attenuating individual property rights in human capital as long as freedom to contract and transact both individually and collectively is respected. Although individual property rights in capital have been attenuated to a different degree in different market economies, any ambition to improve a country's comparative position against international competitors provides an argument against their further attenuation.

Fifth, a major factor that is likely to lift supply elasticities is *freedom to capitalise expected income and the operation of capital markets*. The process of capitalisation of expected revenues provides a powerful leverage for allocational decisions and an accelerator for prompt responses to changes in perceived market conditions and profitability of ventures.

Sixth, a quick supply reaction to movements in prices is assisted by *freeing prices and the terms of trade*. And it could not be otherwise, since freedom to set prices i.e. conditions on which a property right in a good or capital item is alienated belongs in the nature of property rights [2]. The main result of the freedom of prices, would be a major improvement in the degree of availability of goods and factors, their quality and diversity.

Seventh, a quick and adequate reaction of supply to changes in prices is also dependent on the mean and variance of *the expected rate of (open) inflation*. Since movements in relative prices of goods and factors move in proportion to the mean rate of inflation, a high rate of inflation introduces an additional element of informational noise, or uncertainty, in the decisions of suppliers and producers. In addition, a variable rate of inflation makes the situation worse, reducing further the elasticity of supply.

Finally, let us think about the relationship between the rise in prices that would clear the market (the required change in price) and the quality of money as characterised by the ideological, political, legal and institutional factors discussed above. It is not hard to realise that a set of economic laws that are liberal, clear, predictable and inspiring confidence make the required rise in clearing prices lower and, consequently, make the aggregate

[2] Let us note by way of illustration that, for example, the post 1956 preservation of private property rights in land by the Polish farmers accompanied by a net of comprehensive controls of prices and terms of trade (called "socialisation of the countryside") was, in a sense, a degeneration or a mockery of these rights. A crisis of the Polish agriculture was only a function of time.

rate of inflation also lower than a set of illiberal, unclear, unpredictable and incredible laws. Bad laws prop up inflation.

It transpires therefore, that the macro-reallocation of resources from the military to the civilian sectors will not by itself ensure the supplies of civilian goods. If the set of the seven conditions is not fleshed out, fewer guns may be followed by less rather than more butter, thus vindicating Dr. Knopfelmacher's doctrine. This disappointment of the hopes of many will not stand without challenge from the least expected quarters.

Implications for Gorbachev's Reforms

A major conclusion from the above discussion is the need to shorten the transition period from central planning to markets to a minimum. The reformists should stop looking for a third road between socialism and capitalism since such a road has never been found and if found in theory, has never been successfully implemented. If by "socialism" we mean the obvious need to assist the most disadvantaged, then this can and should be done by explicit budgetary channels. Rather than looking for the chimeras of "third roads" or "meeting each other halfway", the reformers should comprehensively reconstruct the laws on economic exchanges, free prices and at the same time reduce inflation by indirect means rather than by the traditional recourse to price controls. They should effectively circumscribe the activities of all groups that strive to attenuate property rights in all forms of capital (including human capital). They should swiftly deregulate their economies as well as capitalise or recapitalise them by creating capital markets.

The fleshing out of these measures appears to be the only way the reformist efforts will not be squandered and the Gorbachev years will not be recalled with regret and nostalgia not only by the successive Soviet and East European generations.

NÈ BURRO NÈ CANNONI

L'articolo dimostra che nelle economie riformatrici di tipo sovietico, in particolare nell'Unione Sovietica, una diminuzione della spesa militare non determina necessariamente una maggior offerta di beni civili, a meno che aumenti *l'elasticità dell'offerta rispetto al prezzo*. Per accrescere questa offerta devono essere soddisfatte varie condizioni, cioè: si rafforzino le aspettative di irreversibilità dei processi di riforma; le forze anti-mercato ossia le forze favorevoli alla nazionalizzazione si indeboliscano; vengano ricreati i diritti di proprietà individuale sui fattori

di produzione; sia rispettata la libertà di entrare e uscire da ogni attività legittima; venga restaurata la libertà di stabilire prezzi e condizioni commerciali; si tronchino le aspettative di inflazione; infine sia abolita la regolamentazione nota col nome di "pianificazione centrale". Vengono esposte anche alcune implicazioni delle riforme di Gorbachev.

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A REEXAMINATION OF THE INFANT INDUSTRY ARGUMENT

by
M. Shahid Alam *

1. *Introduction*

It is the object of this paper to reopen the discussion on some aspects of the infant-industry question which are thought to have been settled in two important papers by Kemp (1960) and Baldwin (1969). In particular, I will show that the analysis of "learning" externalities, arising from knowledge creation in infant industries, needs to be revised in several important respects. It will also be shown that Baldwin's (1969) insistence on the inefficacy of protective tariffs in inducing investments in knowledge is mistaken. These issues will be taken up in two subsequent sections dealing with cost-reductions in infant industries arising from (1) acquisition of skills and (2) additions to knowledge in all other forms. But first, a few words of introduction to the subject of infant industries.

2. *Infant Industries and Market Failures*

Mill (1965, pp. 918-19) endorsed protection as a temporary expedient for industries whose initial excess of average costs over import price was expected to disappear with the acquisition of skills and experience. Many years later, Bastable (1921, pp. 140-43) pointed out that this was not enough; average costs in the infant industry would have to decline below import price so that cost savings would at least be equal to the initial excess costs, both suitably discounted. This has come to be known as the Mill-Bastable test (MBT) for infant-industry investments. But if an investment is

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expected to pass the MBT, then, as Meade (1955, p. 256) noted, private entrepreneurs would be willing to finance the losses of the initial years, and protection would be unnecessary.

Subsequent developments in the literature have shown that failure to establish an infant industry (assumed to pass the MBT) must be attributed to one or more of several kinds of market failures [1]. These include: (a) technological and pecuniary externalities emanating from the learning process in the infant industry, (b) imperfections in the capital market, (c) imperfect information regarding cost-reductions or output-quality in the infant industry, (d) snob value of imports (where the snob value may be an externality conferred on imports by the prestige of the country which produced them), and (e) distortions elsewhere in the economy. While the occasions for market failures in infant industries are numerous, this paper will focus only on technological and pecuniary externalities flowing from the learning process in these industries. It will be assumed generally, therefore, that other problems obstructing the establishment of infant industries do not exist.

Some clarifications on the sources of cost-reductions in the infant industry may be useful here. It will be assumed that cost-reductions stem from the learning process, defined as additions to the infant industry's knowledge concerning its production and market characteristics [2]. These additions to knowledge may be embodied in the industry's work-force, as skills. Alternatively, they may take the form of innovations in machines, products, processes, work-arrangements and worker-management relations, or information about markets for the firm's inputs and products: we shall refer to these as disembodied knowledge (D-knowledge). Normally, a firm's stock of skills can be passed on to another through the transfer of its work-force. But D-knowledge can be transmitted without any movement of the work-force, through observation, casual contacts, industrial espionage, or sale of information by the infant industry or its employees. This dichotomy between skills and D-knowledge has important implications for the analysis of infant industries.

Another distinction may also be noted here regarding the origins of learning in infant industries. It may be the result of investments (in training or research and development), or accrue as a costless byproduct from the

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[1] See CORDEN (1971, p. 250-51).

[2] Other sources of cost-reductions are external to the infant industries. These include the provision of nontraded inputs, both private and public, that were previously missing or available at a higher price. Alternatively, the price of traded inputs may fall as efficient domestic production reduces their price below that of competitive imports.

production process. Writers on infant industries have not always cared to work out separately the implications of these two kinds of additions to knowledge. Some of them, including Meade (1955) and Kemp (1960), base their discussion of infant industries on the implicit assumption that additions to knowledge are costless and, therefore, simply a function of time spent in production. Corden (1971, p. 250) makes this explicit; he has written that the "average costs of a firm are assumed to fall the longer the output has continued; it learns from experience". Other writers, including Ramaswami (1970) and Johnson (1965), take the opposite position, regarding all additions to knowledge in infant industries as resulting from investments. Baldwin (1969, p. 299) recognizes both possibilities but argues "that learning through experience does involve direct costs for any firm".

The distinctions made here concerning the two types of knowledge when combined with the fact that these may be either costless or the result of investments, give us the following taxonomy of the sources of cost-reductions in infant industries: (1) D-knowledge resulting from investments, (2) D-knowledge as a byproduct of production, (3) skills resulting from investments, and (4) skills acquired on the job at no cost to the firm. It may be useful to keep these distinctions in mind when analyzing possible market failures arising from cost-reductions in infant industries.

3. *Acquisition of D-knowledge by Infant Industries*

The existing literature maintains that when D-knowledge acquired by the pioneer firm (PF) in an infant industry is freely available, competition from follower firms (FF) will prevent the former from appropriating the benefits of reductions in its cost below the import price; and the infant industry will fail to get established [3]. Thus, Kemp (1960, p. 66) in his seminal contribution to this literature maintains that whenever the minimum average cost (MAC) of domestic firms falls below the import price, competition from FF (learning from the experience of the PF) will ensure that domestic price is always equal to the MAC. Similarly, Baldwin (1969, p. 297) maintains that when FF can learn from PF, competition "either pushes

[3] When learning is firm-specific no externality exists; hence this case falls outside our purview. It is curious that KEMP (1960, p. 67) should discuss this case in his analysis of infant industries. While an infant industry with firm-specific learning may fail to get established because of a decline in domestic price following the entry of competitors, it is obvious that this competition is not induced by the learning process in the PF and, hence, cannot be regarded as an effect of learning externality.

up factor prices or drives the product's price down to a point where the initial firm is unable to recover its total costs, including the sum spent on obtaining the knowledge – assuming its other costs are the same as those for competing firms entering the field". I will show that these conclusions need to be qualified in important respects.

It is not clear how competition from FF in Kemp's (1960) and Baldwin's (1969) analyses pushes the domestic price to equal the MAC. In a small open economy with a single *exogenous* price for tradables (standard assumptions in trade theory), the entry of FF can have no effect on domestic price in an infant industry. To allow for a decline in domestic price we must introduce a differential between export and import price. But even under this more realistic assumption, competition from FF – following the decline of the PF's MAC below the import price – will push domestic price below the import price *only after* imports have been eliminated [4]. If the volume of imports is fairly large in relation to the output of individual firms, it is quite likely that the PF will have time to recuperate its initial losses before domestic price declines to equal MAC. Furthermore, the decline in domestic price following the elimination of imports need not proceed so far as to equal the MAC of domestic firms. Since the export price will set a floor to the fall in domestic price, the latter will always remain above the MAC of domestic firms whenever the export price exceeds the MAC. Should this happen, it is again possible that the PF may manage to recuperate its initial losses despite the presence of externalities.

But the PF may have to contend with the possibility, as pointed out by Baldwin (1969, p. 297), of being prevented from appropriating the benefits of cost-reductions because of rising input prices brought about by the entry of FF. Where we are speaking of individual infant industries that are moreover small in relation to the manufacturing sector, this possibility appears remote. However, when the infant-industry argument is taken to apply to the entire manufacturing sector, the possibility of rising input prices must be taken more seriously.

Another complication ignored by the literature may be introduced into the analysis of learning externalities in infant industries. It would appear

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[4] I am unwilling to make the assumptions that will lead to instantaneous elimination of the disequilibrium signalled by the decline of the PF's MAC below the import price. In a static economy instantaneous adjustment could be prevented by short run factor-specificity. In a growth context, the constraint may arise from the rate at which investment takes place. *A fortiori*, it is even less plausible that imitation of cost-reductions by FF in the rest of the world will lead to an instantaneous reduction of the world price to equal the MAC of the PF. Information flows across borders are generally costlier than they are inside borders.

from a reading of the literature that learning is a one-way process; firms only learn from their predecessors. This is quite explicit in Kemp (1960) where the time path of MAC of the PF remains invariant with respect to the entry of FF. One-way learning requires that all firms possess identical learning curves. But the learning experience of firms need not be identical. It is quite likely that over time different firms may deepen their understanding of *different* aspects of their technologies. Should this possibility be admitted, the PF may find its cost-reductions speeded up by the entry of FF. Thus two-way learning externality may induce not only a decline in domestic price but also in the costs of the PF. And the net effect of these tendencies for the PF may turn out to be either positive or negative.

Finally, it may be pointed out that discussions in the literature on the profitability of investments in D-knowledge, including my analysis of their shortcomings, have been carried out in the context of industries that are import-competing. While this concentration on import-competing industries follows from the traditional conception of infant industries, it is quite obvious that the problem of learning externalities is equally relevant to exporting and export-marketing activities. It is easily seen that in these activities the entry of FF cannot depress domestic price; this is set by the *exogenous* export price. Clearly, then, learning externalities cannot have an adverse impact on the profitability of investments in exporting and export-marketing activities.

The preceding reexamination of the effects of learning externalities leads us into taking a more careful look at Baldwin's (1969, pp. 298-99) claim about the inefficacy of tariff protection in establishing an infant industry. Baldwin (1969, pp. 298-99) argues that the success of tariffs in supporting the creation of infant industries will depend on whether learning is a byproduct of output or the result of investments. In the first case, he agrees with Meade (1955, pp. 270-71) and Kemp (1960) who argued that tariffs can support the creation of infant industries. However, in the second case, Baldwin (1969, p. 298) maintains that protection will not induce investments in knowledge because "the individual entrepreneur still faces the same externality problem as before, namely, the risk that other firms in the same industry will copy, without cost to themselves, any new technology discovered by them and will then drive the product's price or factor prices to levels at which the initial firm will be unable to recover the costs of acquiring the knowledge". I will show that both when knowledge creation results from investment and it is free, appropriate tariffs will succeed in compensat-

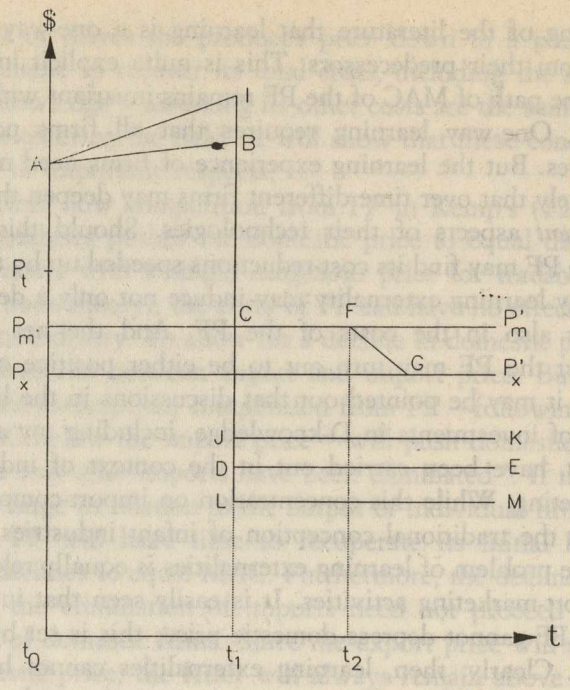

Figure 1

ing the PF for the loss of revenue it incurs from competition by later entrants [5].

Consider an adaptation of Kemp's diagram in Figure 1. The time path of MAC for the PF is given by *ABDE*; it is assumed for simplicity that investment in knowledge takes time to mature, and cost-reductions appear when these investments are completed at time t_1. $P_mP'_m$ represents the time path of import price. Assume that the PF expects to break even if the domestic price equals the import price. It follows that if competition from the entry of FF were to alter the time path of domestic price to $P_mFGP'_x$, investment in the PF would cease to be profitable; the entry of FF eliminates imports at time t_2 and P_x is the export price below which the domestic price cannot fall. This adverse implication of the decline in domestic price

[5] It turns out that for purposes of the present proposition, there is no analytical difference between the two types of infant industries: one where cost-reductions follow as byproduct of output after investments have been completed; and the other where cost-reductions result from investments in knowledge.

may be offset by an appropriate tariff over time period t_0t_1 which raises the domestic price to (say) P_t and whose benefits to the PF when discounted just compensate it for the loss in revenue induced by the entry of FF. Since the tariff does not eliminate the losses of the early period, over t_0t_1, this will not induce FF to enter any sooner than they would without the tariffs; hence the time-path of domestic price after time t_1 is not affected by the tariffs [6]. It may be noted that there is nothing in the preceding argument which would make it inapplicable to the case of the infant industry where knowledge creation is a byproduct of output.

4. *Skill Formation in Infant Industries*

Baldwin's (1969, pp. 300-310) analysis of "ownership" externalities, emanating from acquisition of skills in infant industries, may be faulted for two opposite kinds of errors. He maintains that there are no externalities when skills are firm-specific. Firms pay their workers only what they can earn elsewhere without any risk of losing them; hence, returns from firm-specific skills accrue to the firms. When skills are general, however, he claims that the resulting externalities will prevent firms from investing in workers unless the latter bear the costs. I will show that externalities cannot be ruled out in the first case, whereas in the second case the presence of externalities may not always stop firms from investing in general skills.

Turning to the acquisition of firm-specific skills first, attention may be drawn to two mechanisms that may come into play to raise wages. Becker (1975, p. 30) has pointed out that when laborers possess firm-specific skills their employers will seek to reduce losses from labor turnover by paying workers more than what they can earn elsewhere. We would have the same result if workers used the threat of quitting to appropriate a share in the higher returns accruing to the firm from their skills. Whatever the mecha-

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[6] This is a point of vital importance to my argument. BALDWIN (1969, p. 298) writes that if "there were always some technologically fixed time lag between the introduction of a new, cheaper production technique and the changes in product or factor prices caused by the entry of the firms who freely copied the new production method, a duty would operate to make investment in knowledge acquisition more profitable for an individual firm in the industry. But (to make a point too often ignored in such discussions) the speed with which firms respond to market opportunities is a function of the level of profit prospects. *A duty will make it worthwhile for firms to incur the costs of acquiring the knowledge discovered by other firms (if it is not completely free) faster and also to move into production more rapidly and with greater output rates* (emphasis mine)". This argument is not valid because, as I have shown, profits of other firms need not be altered by the duty.

nism, the end result is the same: there is an excess of wages over the opportunity cost of labor to the firm employing them. And we have a market failure regardless of whether the skills are costless or the result of investments in training.

When general skills result from investments, Becker (1975, pp. 19-26) correctly pointed out that their costs would be carried by workers whose present and future wages would rise as a result [7]. However, he also maintains that if workers do not pay for their training for whatever reasons, firms would not pay for it either, and there would be no investments in general skills. It is easily shown that this cannot generally be true. Firms would be willing to invest in general skills whenever there is a sufficient excess of productivity gains over wage increases that is, moreover, not likely to be eroded away by competition before the cost of investment has been recovered. It follows that if the general training were offered in a small open economy by an export-oriented industry, with the domestic price set exogenously by the export price, domestic competition could not affect price and the net gains from training would continue to accrue to firms investing in them, thereby making general training privately profitable in this case. The same result would also hold for import-competing firms provided they could recover the costs of their investment before imports had been eliminated and domestic price pushed down to erode their net gains. It is in a closed economy that competition – from late entrants who have not invested in general training – is most likely to drive down the product price to a level where the PF would be unable to recover the cost of its investment in general training.

Baldwin (1969, p. 301) maintains that if for some reason workers do not bear the costs of investing in general skills, such investment cannot be induced by tariffs either. The argument is that firms would be unable to recover the costs of their investment in training "because competition from existing firms in the industry as well as from potential entrants will force firms to pay workers their marginal productivity both during and after their training period". Despite the different forms that knowledge takes, this case is analogous to that of the externality caused by investments in D-knowledge that is freely available to all firms. And it may be shown that in this case too an appropriate temporary duty will succeed in inducing firms to invest in general training.

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[7] While BECKER (1975) does not examine the case of skills acquired on the job at no cost to the firm, it is obvious that in this case too rational workers ought to be willing to pay the firm an amount equal to the discounted value of the increase in their future earnings attributable to skills acquired on the job.

Recall that in Figure 1 *ABDE* represents the PF's time path of MAC. The rising segment, *AB*, of this time path now represents the period during which the firm is incurring costs of training; for simplicity it is assumed that the benefits of training are realized only upon completion. The domestic firms are assumed to pass the Mill-Bastable test if the time path of import price, P_mP_m', also represents the locus of domestic price. Should the firms decide to invest in training, they will have to incur higher wages both during the training and upon its completion; and let us assume that the time path of their MAC is given by *AIJK* with the higher wage payments, and *ABLM* without the higher wage payments, making it impossible for them to break even in the first case. As a result the infant industry cannot be established. However, this situation may be remedied by a temporary tariff over the period t_0t_1 such that the discounted value of the additional revenue that it brings to the PF equals the discounted value of higher wages induced by training. The PF breaks even once again, creating conditions for the establishment of the infant industry.

5. *Summary*

The literature on infant industries assumes too readily that profitability of investments will be reduced by the presence of learning externalities – because of a decline in product price or an increase in input price. I have tried to show that the decline in domestic price will not be observed in exporting industries where the domestic price is set by the export price. In import-competing industries too the domestic price in small open economies need not begin to decline until imports have been eliminated; even when imports have been eliminated the export price sets a floor to the decline in domestic price. Furthermore, when allowance is made for the PF to learn from the experience of FF, the loss of revenue ensuing upon the decline in domestic price tends to be offset by additional reductions in the PF's costs.

Again, while the literature maintains that firms have no incentive to invest in general skills because of ownership externalities, it has been argued here that such investments will occur whenever the excess of productivity gains over wage increases is large enough to pay for the cost of training. At the same time, it was pointed out that ownership externalities will exist also when investment takes place in firm-specific skills.

More importantly, this paper has also shown the classical infant-industry argument to be correct: when learning externalities render an investment unprofitable, the problem may be remedied by an appropriate temporary

tariff. The logic of this proposition is quite straightforward. Learning externalities affect infant industries by reducing the benefits received from cost savings; a tariff can be used to compensate for this loss of revenue. It has been shown that the imposition of the tariff does not necessarily accelerate the decline in domestic price in the infant industry.

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RIESAME DELL'ARGOMENTO DELLE INDUSTRIE NASCENTI

Questo articolo cerca di riaprire la discussione sull'argomento delle industrie nascenti. Si mostra che il tasso di profitto degli investimenti non è necessariamente ridotto dalla presenza di esternalità di apprendimento. E, cosa più importante, si afferma che si possono usare dazi protettivi per far nascere un'industria bloccata dalla presenza di esternalità di apprendimento.

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THE VIABILITY OF SAUDI ARABIAN INDUSTRIAL DIVERSIFICATION EFFORTS: THE CONSEQUENCES OF DECLINING GOVERNMENT EXPENDITURES

by
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Introduction

Given the probability that Saudi Arabia will not be able to significantly increase its oil revenues in the near future, the major problem facing the government will be how best to utilize its dwindling oil revenues to generate positive overall rates of economic growth, while at the same time meeting to the fullest extent possible the basic needs of the majority of the population. Clearly any future growth strategy must involve devising means whereby the private sector will assume a more important role in expanding not only output, but perhaps more importantly in sustaining a level of effective domestic demand to stave off any further recessionary tendencies stemming from reduced government expenditures. This is especially critical in the non-hydrocarbon manufacturing sector, which is almost totally dependent on the local market for sales.

In this context, the main purpose of the analysis below is to examine the consequences of declining oil revenues for the Saudi Arabian economy. In particular, the paper is interested in examining several alternative austerity strategies open to the government. In which general areas of government expenditure – consumption (current), investment (infrastructure) or defense (military) – would budgetary cuts be the least disruptive on the non-oil manufacturing sector and in what sense?

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Post-Keynesian Assumptions

For this purpose, a series of Post-Keynesian type relationships were estimated. These examine the various impacts on the economy, and particularly the manufacturing sector stemming from the different classes of government expenditure – investment, consumption, and defense. The Post-Keynesian approach [1] is much too eclectic to adequately summarize here. However, one of its attractive features for examining government policy in Saudi Arabia is that the approach offers a framework for examining the relationship between the components of public sector demand, income distribution and sectoral output.

In place of the relative price variable which is the focal point of a neoclassical analysis, Post-Keynesian theory makes investment the key determinant of the economic aggregates listed above. This follows from an underlying belief that in a dynamic, expanding economy, the income effects produced by investment and other sources of growth far outweigh the substitution effects resulting from price movements. That is changes in demand, both aggregate and sectoral, are due more to changes in income than to changes in relative prices.

Perhaps more importantly, Saudi Arabia possesses a number of structural characteristics that would seem to preclude an automatic equilibration of most markets at or near full employment [2]:

1. Government expenditures play a pervasive role in the economy, accounting in recent years for well over half of aggregate demand.

2. Financial markets are underdeveloped, with the interest rate playing an insignificant role due to Islamic codes concerning usury.

3. The relatively low population base puts some limit on the size of the market and competition.

4. A sectoral imbalance is dominated by oil in accounting for real output and by services in respect to employment. This situation creates an environment whereby a large gap exists between income creation and demand generation that must be closed by government expenditures. The implications of this situation in terms of markets are:

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[1] Cf. EICHNER and KREGEL (1975).

[2] NAGI (1982, p. 13).

(*a*) A price mechanism that is way above the real value, especially in real estate, land and non industrial properties, and

(*b*) A wage mechanism that is tied to inflation and oil revenue and is only remotely connected with real productivity.

In sum, a Post-Keynesian approach was selected for the analysis below because it is capable of explicitly considering, given the pervasive role of government expenditures (as opposed to market-determined allocations), how economic performance can be improved over the extrapolation of short run trends.

Fiscal Patterns

Budgetary revenue and expenditure increased steadily up to 1974, except for 1967/68 when dislocation following the Israeli-Arab war affected all economies in the region. However, the 1973/74 and 1979 oil price jumps, world recession and fluctuations in the world demand for oil, and political instability and warfare in the Gulf have led to sizeable year to year fluctuations in budgetary receipts compared to expectations.

Although the general trend remained buoyant until 1981/82 in 1977/78 and 1978/79, slight budget deficits followed unexpectedly low oil revenues, whereas expenditure and revenue both rose higher than projected during the next two years. The 1982/83 budget was the first in which an absolute decline in revenue was projected, the objective being to arrive at a balance, while in 1983/84 a planned deficit of SR35 billion was budgeted for the first time in recent history.

In 1984/85 the planned deficit was increased to SR46 billion (Table 1) with budget revenue and expenditure figures SR214 billion and SR260 billion respectively. The 1985/86 budget was supposed to balance at SR200 billion, but ended with a SR50 billion deficit. The 1986/87 budget was not published in March 1986 as due, because of uncertain revenue forecasts. Monthly disbursements continued on the basis of average spending in 1984/85. A new budget was finally released at the end of December 1986 to cover the 1987 calendar year. This projected revenue at SR117 billion, compared with SR340 billion envisaged in the budget for 1981/82.

Over the same period, the government had reduced government spending from SR298 billion to SR160 billion, a significant achievement, but not enough to close the deficit gap. In 1988 another large budget deficit was projected, but the government acknowledged the dwindling size of its budg-

TABLE 1

SAUDI ARABIA: GOVERNMENT BUDGET ESTIMATES, 1984-1988

(SR million)

	1984	1985	1986	1987	1988
Total Revenue	225,00	214,000	200,000	106,926	105,300
Oil Revenue	164,496	164,500	154,250	74,183	73,525
Other Revenue	60,504	49,600	45,750	32,743	31,775
Total Expenditure	260,000	260,000	200,000	159,646	141,200
Human Resources	27,736	30,413	24,533	23,689	23,388
Transport	24,950	22,175	14,497	10,904	9,493
Economic Development	13,202	12,533	9,081	6,615	5,888
Health	13,591	16,134	12,892	11,094	10,806
Infrastructure	9,582	9,833	6,924	4,299	3,555
Municipal Services	19,070	17,063	11,890	8,110	7,017
Defense	75,565	79,892	63,956	54,226	50,080
Public Administration	47,218	43,928	38,584	30,974	25,058
Govt Lending Inst.	20,000	17,500	9,300	3,590	590
Local Subsidies	9,086	10,529	8,343	6,145	5,325
Balance	−35,000	−45,900	–	−52,720	−35,900
Balance	–	–	–	–	30,000

Source: SAUDI ARABIAN MONETARY AGENCY, *Annual Report*, various issues.

et reserves by launching a local borrowing scheme to cover a substantial portion of the revenue shortfall. Import duties were also raised in an attempt to generate more non-oil revenue, but other measures such as tax increases were rescinded following public protest.

As well as declining oil revenues the government has had to contend with a drop in overseas investment income, which has resulted from a fall in international interest rates and a reduction in the size of the government's overseas assets from around $150 billion in 1982 to less (estimated) than $60 billion by the end of 1988 [3].

One of the main problems for the government is that current expenditure has proved very difficult to pare back; there are huge costs involved in running and maintaining the activities established by development project capital inputs – in social services as well as physical infrastructure. Defence expenditure remains a major budget item.

[3] RICHIE (1987, p. 169).

In terms of recently released figures, in 1986 (March-December), actual domestic revenue was only SR16.5 billion, government domestic spending was SR88.2 billion, and government direct foreign exchange spending was SR37.6 billion. By the end of 1987 central government reserve accounts lodged with SAMA had fallen to SR78 billion, down from SR118.5 billion at the end of 1986. This SR40.5 billion drop probably reflects fairly accurately the actual size of the 1987 budget deficit, against a budgeted SR52.7 billion. If the budgeted 1988 deficit of SR36 billion had been fully financed from reserves rather than borrowing, these government deposits might have been expected to have halved by the end of 1988 to less than $10 billion.

The growing government preoccupation with cutting its budget deficit is being translated into a number of schemes devised to tap the savings of state organizations (the Pension Fund has around SR60 billion) and the private sector. Expenditure rationalization and efficiency increases have also been attempted but are proving elusive targets.

Government bond issues are the most obvious example of attempts to tap sources of savings other than the government's own dwindling reserves, the more so since various amendments to the offering terms have been introduced. These changes have gradually widened the groups of potential end-investors. Before the bonds were even offered to banks, it is estimated that some SR14 billion may have been placed with the government Pension Fund. The bonds were then offered to banks, some of which gained permission to place them in a package of national assets offered to private investors in the form of a unit trust.

Finally, towards the end of September 1988 the Saudi Arabian Monetary Agency (SAMA) announced that banks would be able to sell the bonds directly to the Saudi public in minimum tranches of SR1 million; purchasers would get a certificate of purchase rather than the bonds themselves as the banks would still collect interest from them, and would be forbidden to sell them on to non-Saudis. Firm details on the number and success of the bond offerings are scarse, which seems to confirm both that the bank's take has been lower than hoped for, and that the scheme itself is still seen as rather controversial.

The success of the government borrowing program will be judged not just by the levels of commercial bank and private sector subscriptions to tranche issue, but also by the extent to which these investors are prepared to repatriate funds from abroad to purchase the bonds. As yet there is no firm evidence to show whether the purchases are being financed from domestic or foreign savings.

Figures recently published by the Saudi Arabian Monetary Agency [4] provide an insight into the extent of the government's problem, and the nature of commercial banks' net foreign asset position. In the ten month interval between budgets in 1986, direct government foreign exchange spending stood at SR37.6 billion, domestic spending at SR88.2 billion, domestic revenue at SR16.5 billion, and net domestic cash flows (defined as domestic spending minus domestic revenues) at SR71.7 billion. If the government could cover its foreign exchange spending with foreign currency repatriated via the bond issues, it would mean that government oil revenue and overseas investment income could all be put at the disposal of SAMA to meet private sector foreign exchange demand.

On the other hand, if government borrowings are to be covered by riyals savings, and could therefore be classified in the same vein as domestic revenue, it becomes clear that this method of borrowing will decrease the net domestic cash flow, along with the stimulus that the government budget has traditionally given to the economy. This might be expected eventually to lead to less demand for foreign exchange throughout the economy, rather than to bring about an increase in foreign exchange availability. Funding the bond issues from domestic resources thus has a much clearer deflationary impact, which might be expected to hurt the independent growth of the private sector.

As far as the commercial banks are concerned, the true extent of their net foreign assets position is often overstated, by a tendency not to nest out residents' foreign assets denominated in Saudi riyals. In mid-1987 when Saudi commercial banks' foreign assets are standing at SR88.6 billion, and foreign liabilities at SR16.8 billion, giving a net foreign asset position of SR71.8 billion, the banks were also holding SR28 billion in residents' foreign currency deposits, while their net foreign position in Saudi riyals was SR20.6 billion. In other words, their true net foreign assets position could be more correctly stated at only SR23.2 billion.

The figure for the size of the offshore riyal market is only reported in the SAMA *Annual Report*, but it might be assumed to have grown in 1987/88 following the removal of withholding Tax. Assuming the net figure for this market has not risen to SR25 billion, a truer net foreign asset figure for Saudi commercial banks would seem to be SR17.7 billion – insufficient to cover more than half the planned 1988 budget deficit. It is clear then that the commercial banks alone cannot be expected to cover the budget deficit in foreign currency, or at least not until a clearer line of the

[4] *Annual Report* (1986, 1987).

riyal persuades local depositors to switch out of foreign currency deposits.

It is clear then that the government will have great difficulties in raising sufficient funds to continue expenditures at recent levels. Other methods, expenditure reductions and/or redirection seem a more realistic solution to the country's budgetary problems.

Budgetary Strategies

At first sight, the most logical austerity program would be one of concentrating on a selective reduction in defense expenditure allowing resources to be freed up to finance (more productive) government programs. Defense alone accounts for 25-35 percent of the national budget. As noted above (Table 1) despite the decline in oil revenues, defense expenditures have fallen only moderately.

In relative terms, the kingdom ranks first in the world in military expenditures per capita, and in military expenditures per soldier. In contrast the country ranks fifth in education expenditure per capita, and thirteenth in health expenditures per capita [5].

It is not at all clear how much of the allocations to defense are in excess of what is needed on purely strategic grounds. Although Saudi Arabia has spent massively on developing an extensive military infrastructure and in purchasing the most sophisticated hardware available, the rationales for this expenditure have been articulated in only the most general terms.

These are to enable the kingdom to protect its extensive borders from regional or superpower incursions and to ensure internal security [6]. In terms of constraints, the country's purchasing program has been limited only by the lack of absorptive capacity, trained manpower and the willingness of the U.S. to supply certain weapons systems.

The first dilemma therefore facing the Saudi authorities is whether the country can justify the high costs of military expenditures when a distinct possibility exists that cut backs in defense could free up sufficient funds to offset most of the budgetary cuts in the non defense area brought about by the oil price declines.

Along these lines, classical theory would predict on the basis of resource allocation that increases in defense will decrease investment and/or civilian consumption and thus reduce industrial output. Increased military

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[5] SIVARD (1985, pp. 40-41).

[6] ECONOMIST INTELLIGENCE UNIT (August 1986, p. 6).

burdens would, in this situation, have to be justified on the basis of other social welfare gains such as an increase in collective security. Keynesian theory, on the other hand, suggests that in the presence of inadequate effective demand the operation of the income multiplier would result in an increase in industrial output, resulting from additional defense expenditures. Of course one could always argue that expenditure on either consumption or investment would have a greater domestic expenditure multiplier on private sector incomes and rates of production than that produced by military expenditures. Thus, there are purely economic rationales for increased military spending. Whether or not military expenditures have a positive economic impact relative to other sources of demand is ultimately an empirical question [7].

The second budgetary dilemma currently facing the Saudi authorities concerns the wisdom of further expanding the kingdom's infrastructure. During the last decade, Saudi Arabia has had perhaps the largest ever program of investment in transport and related infrastructure. Since the expansion in oil revenues in 1973/74 the country invested in a wide variety of programs to expand not only its road network, but sea and air ports as well. In large part, the rationale for this program was based on the presumption that the cost reducing impact of this investment would make private investment much more profitable, and thus stimulate a major expansion in private sector output.

The possibility that public sector investment in infrastructure can stimulate not only increased levels of private sector investment, but overall increases in industrial output as well, has long intrigued economists. This possibility is clearly suggested by infrastructure's key role in Hirschman's unbalanced development strategy [8].

Tersely put, Hirschman advocated that in countries where the private sector is somewhat squeamish about risk-taking, the government could stimulate private sector capital formation, and follow on increases in industrial output through massive investments in such areas as transportation, and energy thereby reducing the costs of commercial production. While not explicitly acknowledged, Hirschman's notions of imbalance through massive investments in infrastructure underlie Saudi Arabia's development strategy [9].

In terms of financing, the Saudi authorities have spent more on infrastructure in the last fifteen years than any country in history over a similar time period. Since 1970 when the country initiated its first development

[7] Deger and Smith (1985, p. 6).

[8] Hirschman (1958).

[9] Looney and Frederiksen (1985).

plan, the government with the completion of the Third Plan in 1985 had allocated approximately 375 billion riyals to development infrastructure (during most of this period the exchange rate was around 3.5 Rls to the U.S. dollar).

In terms of the focus of the present study, the relevant question is whether the Saudi Arabian government's strategy of infrastructure led investment has been successful in the Hirschman sense i.e., has it resulted in distinctly higher levels of industrial output over and above the levels likely to exist in the absence of these programs? If not, what impacts have been associated with infrastructural investment and have these effects been superior to those that would have resulted from either consumption or military expenditures?

The third major area of budgetary concern involves the role of government consumption in Saudi Arabia. How the government divides its expenditures between consumption (current) and other types of allocations has a significant impact on the relative incomes of the middle- and high- income groups in the kingdom [10].

The mechanisms the Saudi Authorities have for transferring oil income to the private sector are: (1) subsidies of various types, (2) the wages and salaries the government pays its employees, and (3) profits generated in the private sector. The first two mechanisms involving government consumption are fairly self explanatory. The third, however, requires some elaboration. Since the government is the most important buyer and investor in the kingdom, a major source of private income is the profits earned by Saudis acting as middlemen between the government and foreign firms in the purchase of imported goods or large construction contracts [11]. In addition, many of these businessmen own large construction firms and act as contractors themselves.

How the government spends its oil revenues can therefore have a significant impact on the relative incomes of the middle- and high-income groups in the kingdom. A major middle income group is made up of professionals and administrators employed in the public sector. By raising the salaries of these employees, the government can easily improve the position of the middle class. On the other hand, an increase in purchases of military hardware and expansion of government investment expenditures at the expense of public sector salaries would increase the relative income of middlemen and contractors.

Government expenditure may also affect the distribution of income

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[10] KAVOURSSI (1983, pp. 74-75).

[11] BEBALWI (1987).

through its differential impact on various income groups. Here, the presumption is that the upper income groups and middlemen will be in a better situation to avoid the inflation tax relative to their middle income, administrator counterparts. We should, therefore, expect to find that inflation tends to reduce the over all level of consumption, while quite possibly increasing private investment (on the presumption that the upper income groups do most of the investment in the kingdom, and that a large share of this investment is financed from income rather than the financial markets).

Unfortunately in testing these assertions about the impact of government activity on the private sector, we do not have reliable data on changes (or for any year for that matter) in income distribution over time. Implicitly, however, the analysis below assumes that government expenditures affect income distribution as manifested in the over all impact it has on aggregate private investment and consumption. Based on the assumption that middle and lower income groups account for a relatively high share of consumption and a low share of investment, movements in these two aggregates as affected by government expenditures should provide a general picture of the direction in which the country's income distribution has changed over time.

Operational Definitions

In order to gain some insight into the manner in which public expenditures – infrastructure, consumption and defense – impact on various facets of the Saudi economy, several Post-Keynesian type equations were first estimated examining the impact of these allocations on private consumption and investment. Here the greatest difficulty involves the lack of data as to the value and composition of the kingdom's stock of infrastructure. In particular official Saudi data on government investment contains both infrastructural and non-infrastructural type expenditures. Conceivably the cost reducing effect of the infrastructure component of government investment could be offset by the potential (inflationary) crowding out of private sector activity stemming from the non-infrastructural component.

To avoid these potential problems it was first necessary to separate out and estimate the independent effects of the different categories of public investment. Since the raw data itself does not allow these distinctions to be made, a proxy measure for the infrastructural and non-infrastructural components of government investment had to be developed. Operationally this involved making a distinction between types of public investment on the basis of whether or not that investment was expected.

Expected investment was assumed to be depicted by the trend in government investment [12]. Again, it is assumed that expected public investment, *GIE*, reflects investment in infrastructure. Similarly, transitory government investment was assumed to be depicted by that component of public investment that was unexpected. Operationally, unexpected public investment (*GIU*) was defined as the difference between the actual (realized) level of government investment (*GI*) and what was expected (*GIE*). Clearly, the basic assumption underlying these proxies is that infrastructure investment is an on going process that moves slowly over time and cannot be changed very rapidly.

A final factor that needs to be taken into account is the potential problem of real or physical crowding out. It is a well-accepted proposition that in Saudi Arabia absorptive capacity has been a problem, particularly in the early oil boom years [13]. By definition, public sector expenditures can result in crowding out if it utilizes physical and financial resources that would otherwise go to the private sector. Furthermore, the financing of public sector investment, whether through taxes, issuance of debt or inflation will lower the resources available for the private sector thus creating a situation that may depress private investment activity. Operationally a negative sign on unexpected government investment (*GIU*) can be assumed to reflect crowding out of private sector investment due to excessive allocations to non-infrastructural uses.

In a similar manner, proxies were developed for permanent and transitory government consumption, with permanent consumption (*GCE*) reflective of long term trends in government salaries and subsidies and transitory government consumption (*GCU*) reflecting short term adjustments to changing revenues.

Expected military expenditures (*MEE*) are reflective of long term weapons acquisition and infrastructure development, while unexpected military expenditures (*MEU*) were assumed to reflect short run responses to changes in the kingdom's perceived security situation.

Impact of Government Expenditures

The Post-Keynesian approach towards investment and output is much more eclectic than its neo-classical counterpart. Here, investors rather than

[12] The trend in expenditures was estimated using a linear regression with time. Expected expenditures were calculated as in BLEJER and KHAN (1985).

[13] LOONEY (1982).

attempting to bridge the gap between the existing capital stock and an optimal one, are seen as largely responding to changes in expectations concerning future profitability.

Post-Keynesians also emphasize the importance of credit availability in enabling business firms to bridge any gap between their desired level of discretionary spending and the current rate of cash inflow. Of course Post-Keynesian models have been developed largely for the advanced, mature industrial countries where sophisticated financial systems exist, together with central banks capable of altering such variables as the level and structure of interest rates.

Adapting the Post-Keynesian approach to the Saudi Arabian situation entails making a number of assumptions as to the relevant indicators used to reflect perceived changes in business profitability:

1. Subsidies either direct or indirect by the government to the private sector, while very important are, given the data, somewhat difficult to pin down. For purposes of estimates here, they are assumed to vary more or less in line with the amount of distributed loans (*INDCR*) from the Saudi Industrial Development Fund.

2. The expected rate of inflation (*INFE*) may affect investment and output decisions in manufacturing, particularly as anticipated increases in future prices may increase the perceived profitability of non-traded activities relative to manufacturing. This is one aspect of the so called "Dutch Disease" effect [14].

3. Credit tightness (*CBPSPE*) is depicted as the expected level of real commercial bank credit, and is computed in a manner similar to the expected levels of investment described above. Presumably increases in the expected level of credit would be reflective of easing credit conditions.

4. In a Post-Keynesian framework crowding out of private sector activity can result from excessive military expenditures (*MEU*), government consumption (*GCU*) in addition to non-infrastructural investment (*GIU*).

Impact on Inflation

Operationally, the impact of infrastructure investment on inflation is

[14] LOONEY (1988/89).

modeled by a blending of the Hirschman/Voigh [15] and Glover/Simon [16] approach towards impacts stemming from the infrastructure development process. If infrastructure plays a role similar to that envisaged by Hirschman and Voigh, we should expect to find the resulting potential increase in the rate of return on various commercial activities inducing the private sector to increase its level of real output. While likely to be inflationary in the short run, over time, this should result in a closing of the inflationary gap created by the infusion of purchasing power associated with the construction phase of the infrastructure expansion program.

On the other hand, if the Glover and Simon view of the role of infrastructure is more appropriate in explaining private sector behavior, we would expect the private sector's expectations of future government actions, including likely extensions of the country's infrastructure to play a predominant role in shaping its decisions to expand output and or investment. However, the new higher level of output, depending on the way it is financed, may result in an over-expansion of the money supply neutralizing the longer run anti-inflationary effect of the induced expansion of infrastructure.

In the model that follows attempts are made to incorporate the inflationary effects of infrastructure implicit in both the Hirschman/Voigh and Glover/Simon approaches.

The model used to examine the differential impact of government expenditures on inflation in Saudi Arabia incorporates the considerations outlined above:

1. In particular proxies for "permanent expenditures", the expected level of government investment (*GIE*), consumption (*GCE*), and defense (*MEE*) were included in the regression equation to determine the longer run inflationary effect (if any) associated with the expanding role of the government in the economy.

2. Shorter run impacts of government expenditures on inflation were modeled using the measure of unexpected increases – *GIU*, investment, *GCU* consumption and *MEU*, defense defined above.

3. The impact of world price movements on the Saudi Arabian price level was included to reduce any biases stemming from the period of world

[15] VOIGH (1974).

[16] GLOVER and SIMON (1974).

inflation occurring in the mid to late 1970s. Since Saudi Arabia does not publish figures on the price of imports, this variable was proxied by the International Monetary Fund's industrial countries' export price index. This index was lagged one year (*INFWL*) to allow changes in import prices to work themselves through the domestic cost structure.

4. Inflation is also assumed to be a function of inflationary expectations (*NODEE*). As with the other expected values derived above, this factor was proxied by regressing the non-oil price deflator on its value in the previous year, and using each year's predicted value in the regression equation.

5. The potential impact of excess money balances on the non-oil price deflator was treated by including the money supply (*M*1) in the regression equation.

6. The reduction in inflationary pressures stemming from increased real supplies of goods and services was proxied by non-oil *GDP* (*YNO*).

In terms of expected signs, the inflationary impact of infrastructure was assumed negative, while government consumption and military expenditures by creating demand, but not augmented supplies were assumed to be positive. Unexpected values for all three types of expenditure were assumed, for similar reasons, to have a positive impact on inflation.

Finally, to test the generality of the model regressions were performed using both the non-oil *GDP* deflator (*NODF*) and the consumer price index (*CPI*).

Summarizing the above in equation form (with expected signs):

$$INF = f[INFE\,(+),\ INFWL\,(+),\ M1\,(+),\ YNO\,(-),\ GEE\,(-\ +),\ GEU\,(+)]$$

where:

INF = the non-oil *GDP* deflator (and the consumer price index);

INFE = expected increase in the non-oil *GDP* deflator (and the consumer price index);

INFWL = export price index of the industrialized countries (lagged one year);

*M*1 = the money supply as defined by the International Monetary Fund;

GEE = expected government expenditures
GIE = government investment (mainly infrastructure)
GCE = government consumption (mainly permanent salaries)
MEE = military expenditures
GEU = unexpected government expenditures
GIU = unexpected changes in government expenditure
GCU = unexpected government consumption
MEU = unexpected military expenditures

Empirical Results:

Impact of government investment on the non-oil price deflator

(1) $INF = 0.89\ INFE + 2.64\ INFWL + 0.003\ Ml - 0.03\ YNO$
$\quad\quad\quad

1. It is clear that infrastructure investment in Saudi Arabia has reduced inflationary pressures.

2. The transitory (non-infrastructural) component of government investment does not appear to have contributed to inflationary pressures over the period examined (1960-85).

3. World inflation has been imported into Saudi Arabia, and has contributed significantly to increases in the non-oil GDP deflator.

4. Contrary to the situation found in many other countries, the money supply does not appear to have made an independent contribution to inflation.

5. Government consumption, both permanent and transitory appears to have made a major impact on the price level.

6. Military expenditures appear somewhat neutral in their inflationary impact.

The importance of the composition of government expenditures in affecting inflation is also illustrated by the fact that the over-all level of government expenditures (including both permanent, *GEE* and transitory components, *GEU*) is not statistically significant in affecting the price level:

$$
\begin{array}{lccccccc}
(4)\ INF = & 0.84 & INFE + & 1.91 & INFWL - & 0.008 & M1 - & 0.02 \quad YNO \\
 & (9.88) & & (3.68) & & (-\ 0.91) & & (-\ 1.03) \\
 & + 0.003 & GEE + & 0.004 & GEU - & 0.28 & RHO & \\
 & (1.04) & & (0.21) & & (-\ 1.35) & &
\end{array}
$$

$$r2 = 0.999;\ F = 2163.5;\ DW = 1.80$$

The results obtained using the consumer price index were very similar to those found for the non-oil *GDP* deflator, and hence do not appear to warrant further discussion.

Impact on Manufacturing

The mechanism by which exports could act as an engine of growth (or leading sector) and the determinants of the overall impact of an export stimulation on the economy is well known. In the classic situation of staples, exports contributed to economic growth directly (through direct con-

tributions to Gross Domestic Product), and indirectly through contributions to *GDP* per medium spread (or carry-over) effects.

Since oil revenues in the Middle East accrue, for all practical purposes, solely to the host governments and in addition have very few linkages to the domestic economy, their impact on development largely depends on when and how they are spent. As with the classic case of staples, we can conceptualize two major impacts on economic development: a direct one through the government allocation process for consumption, investment or defense, and an indirect one over time where the general increase in non-oil gross domestic product stemming from earlier government allocations spreads through the economy.

This indirect contribution to growth embraces Hirschman-type linkages, and can broadly be considered as a sequence of multiplier-accelerator mechanisms whereby increases in non-oil *GDP* augment demand for various sectoral – manufacturing, services, distribution – outputs. Theoretically, indirect contributions (or spread effects) can continue to accrue long after some export stimulus has occured. The overall impact of an export stimulus on the economy has many determinants including technology, the propensity to import, the extent to which investment opportunities generated are accepted domestically, the ability to attract foreign factors and so on.

Obviously, neither the timing pattern exhibited by, nor the relative sizes of, exports' direct and indirect contributions to growth need to be fixed and could conceivably vary between subperiods, especially over long periods of economic development. Provided that investment opportunities generated by the growth of the export sector are exploited, the model predicts that economic growth will be a process of industrial diversification around an export base.

Has Saudi Arabian industry been able to diversify around their export bases directly, through increases in government expenditures? Or has the process of industrial growth stemmed largely from indirect or spread effects? Do similar patterns exist for the country's other major sectors – agriculture, construction, trade and services?

The general form of the equation used to estimate the relative importance of spread vs linkage effects was of the type:

MANUF = DUTCH, SPREAD, LINKAGE, CREDIT

Where:

1. *DUTCH* refers to the increase in the relative profitability of non-traded goods brought about as a result of oil boom related government expendi-

tures. This effect is proxied by the expected, *INFE* and unexpected rates of inflation *INFU*.

2. *SPREAD* refers to the increase in demand for output brought about by the overall growth of the non-oil sector of the economy, and is depicted by the expected *YNOE* and unexpected *YNOU* increases in non-oil *GDP*.

3. Linkage refers to the link in output to government expenditures and is depicted by the expected *GE* and unexpected *GU* increases in government expenditures. Here government expenditures are government consumption, investment, military and total expenditures. As a basis of comparison, private consumption both expected *PCE* and unexpected *PCU* are included.

4. *CREDIT* refers to Saudi Industrial Development Fund, *INDCR*, and the expected rate of commercial bank credit, to the private sector, *CBPSPE*.

In general the results for manufacturing (Table 2) indicate that:

1. Inflationary factors associated with the Dutch Disease have had a considerable retarding effect on Saudi Arabian manufacturing. This is evidenced by the negative sign and generally high statistical significance on the expected inflation term, *INFE*. Unexpected inflation appears to have had a lesser impact.

2. Spread effects have been considerably stronger than government expenditures in stimulating manufacturing. In fact there is some evidence that the crowding out of resources from manufacturing, particularly as a result of government investment, has been a major problem in Saudi Arabia.

3. Private consumption and industrial credit appear particularly important in stimulating increases in manufacturing output (Table 2, equation 5).

As a basis of comparison, similar equations were estimated for the agricultural sector (Table 3), construction (Table 4), trade (Table 5), and transport/communications (Table 6).

The results for agriculture (Table 3) show some similarities to those obtained for manufacturing:

1. In general inflationary expectations have had a negative impact on the growth of the agricultural sector. Since agriculture is also a good traded

TABLE 2

SAUDI ARABIA: EXPENDITURE IMPACT ON MANUFACTURING, 1965-85

Impact of government consumption

(1) *MANUF* = − 1.36 *INFE* − 1.57 *INFU* + 0.79 *YNOE* + 0.74 *YNOU*
(− 4.20) (− 1.90) (5.03) (3.86)

+ 0.04 *GCE* − 0.19 *GCU* − 0.16 *RHO*
(0.19) (− 1.51) (− 0.70)

$r2 = 0.996$; $F = 576.87$; $DW = 1.97$

Impact of government investment

(2) *MANUF* = 0.07 *INFE* − 0.94 *INFU* + 0.67 *YNOE* + 0.59 *YNOU*
(0.14) (− 1.25) (8.76) (5.48)

− 0.39 *GIE* − 0.19 *GIU* + 0.42 *RHO*
(− 3.32) (− 1.10) (2.10)

$r2 = 0.991$; $F = 246.74$; $DW = 1.82$

Impact of defense expenditures

(3) *MANUF* = − 1.14 *INFE* − 0.76 *INFU* + 0.91 *YNOE* + 0.80 *YNOU*
(− 2.79) (− 0.76) (8.01) (4.97)

− 0.26 *MEE* − 0.06 *MEU* + 0.27 *RHO*
(− 1.62) (− 0.36) (1.28)

$r2 = 0.990$; $F = 218.49$; $DW = 1.76$

Impact of total government expenditures

(4) *MANUF* = − 0.62 *INFE* − 0.18 *INFU* + 0.98 *YNOE* + 0.87 *YNOU*
(− 1.76) (0.23) (12.33) (6.87)

− 0.30 *GEE* − 0.21 *GEU* + 0.12 *RHO*
(− 3.34) (− 3.21) (0.52)

$r2 = 0.996$; $F = 494.21$; $DW = 1.92$

Impact of private consumption and industrial credit

(5) *MANUF* = − 1.56 *INFE* − 0.74 *INFU* + 0.75 *INDCR* + 0.41 *YNOE*
(− 3.70) (− 5.51) (4.46) (2.75)

+ 0.18 *YNOU* + 0.56 *PCE* + 0.34 *PCU* − 0.76 *RHO*
(0.95) (3.62) (2.62) (− 5.27)

$r2 = 0.998$; $F = 1062.65$; $DW = 2.56$

Notes: Estimates were made using a Cochrane-Orcutt iterative estimation procedure to correct for serial correlation. $r2$ = coefficient of determination; $F = F$ statistic; DW = Durbin Watson Statistic; ( ) = t statistic

TABLE 3

SAUDI ARABIA: EXPENDITURE IMPACT ON AGRICULTURE, 1965-85

Impact of government consumption

(1) $AG =$ − 3.02 *INFE* − 6.94 *INFU* + 0.90 *YNOE* + 0.03 *YNOU*
(− 5.11) (− 4.57) (3.22) (− 0.07)

+ 0.21 *GCE* − 0.17 *GCU* − 0.50 *RHO*
(0.19) (− 1.51) (− 2.62)

$r2 = 0.962$; $F = 55.51$; $DW = 2.06$

Impact of government investment

(2) $AG =$ − 2.71 *INFE* − 7.44 *INFU* + 0.68 *YNOE* − 0.32 *YNOU*
− (3.62) (− 5.38) (5.67) − (1.17)

+ 0.04 *GIE* − 0.15 *GIU* − 0.64 *RHO*
(0.26) (− 0.34) − (3.81)

$r2 = 0.967$; $F = 63.95$; $DW = 2.15$

Impact of defense expenditures

(3) $AG =$ − 2.89 *INFE* − 3.65 *INFU* + 1.22 *YNOE* + 0.63 *YNOU*
(− 7.68) (− 2.74) (8.13) (2.02)

− 0.76 *MEE* − 0.32 *MEU* + 0.49 *RHO*
(− 2.96) (− 1.48) (2.51)

$r2 = 0.981$; $F = 113.23$; $DW = 2.34$

Impact of total government expenditures

(4) $AGP =$ − 2.79 *INFE* − 7.58 *INFU* + 0.66 *YNOE* − 0.25 *YNOU*
(− 4.81) (− 5.18) (3.72) (− 0.71)

+ 0.05 *GEE* − 0.06 *GEU* − 0.59 *RHO*
(0.27) (− 0.36) (− 3.24)

$r2 = 0.996$; $F = 60.79$; $DW = 2.06$

Impact of private consumption, expected commercial bank credit

(5) $AGP =$ − 4.35 *INFE* − 7.12 *INFU* + 3.69 *CBPSPE* − 0.31 *YNOE*
(− 7.32) (− 7.12) (5.63) (− 1.17)

− 0.33 *YNOU* + 0.93 *PCE* + 0.74 *PCU* + 0.23 *RHO*
(− 1.44) (4.58) (4.42) (1.07)

$r2 = 0.964$; $F = 46.73$; $DW = 2.22$

Notes: Estimates were made using a Cochrane-Orcutt iterative estimation procedure to correct for serial correlation. $r2$ = coefficient of determination; $F = F$ statistic; DW = Durbin Watson Statistic; ( ) = t statistic

TABLE 4

SAUDI ARABIA: EXPENDITURE IMPACT ON CONSTRUCTION, 1965-85

Impact of government consumption				
(1) *CON* =	2.32 *INFE*	+ 2.23 *INFU*	− 1.32 *YNOE*	− 0.90 *YNOU*
	(8.40)	(3.87)	(− 1.06)	(− 0.74)
	− 0.36 *GCE*	+ 1.23 *GCU*	+ 0.38 *RHO*	
	(− 0.24)	(1.55)	(− 2.62)	
			$r2 = 0.984$; $F = 141.25$; $DW = 1.67$	
Impact of government investment				
(2) *CON* =	1.33 *INFE*	+ 2.30 *INFU*	− 0.46 *YNOE*	+ 0.75 *YNOU*
	(4.09)	(4.22)	(− 0.97)	(0.86)
	+ 0.25 *GIE*	+ 0.15 *GIU*	− 0.02 *RHO*	
	(3.25)	(1.034)	− (0.07)	
			$r2 = 0.994$; $F = 384.31$; $DW = 2.03$	
Impact of defense expenditures				
(3) *CON* =	2.03 *INFE*	+ 1.38 *INFU*	− 0.25 *YNOE*	− 0.16 *YNOU*
	(8.86)	(2.07)	(− 3.50)	(− 1.44)
	+ 0.33 *MEE*	+ 0.02 *MEU*	+ 0.08 *RHO*	
	(3.13)	(0.20)	(0.34)	
			$r2 = 0.993$; $F = 298.4$; $DW = 1.88$	
Impact of total government expenditures				
(4) *CON* =	1.68 *INFE*	+ 1.36 *INFU*	− 0.24 *YNOE*	− 0.16 *YNOU*
	(6.76)	(2.53)	(− 4.36)	(− 1.90)
	+ 0.21 *GEE*	+ 0.18 *GEU*	+ 0.17 *RHO*	
	(3.40)	(4.23)	(0.77)	
			$r2 = 0.993$; $F = 328.79$; $DW = 1.95$	
Impact of private investment				
(5) *CON* =	2.58 *INFE*	+ 2.45 *INFU*	− 0.60 *YNOE*	+ 0.30 *YNOU*
	(8.12)	(4.54)	(− 1.08)	(0.35)
	− 0.73 *PIE*	+ 0.17 *PIU*	+ 0.19 *RHO*	
	(− 2.01)	(0.78)	(0.87)	
			$r2 = 0.991$; $F = 233.24$; $DW = 1.88$	

Notes: Estimates were made using a Cochrane-Orcutt iterative estimation procedure to correct for serial correlation. $r2$ = coefficient of determination; $F = F$ statistic; DW = Durbin Watson Statistic; ( ) = t statistic

TABLE 5

SAUDI ARABIA: EXPENDITURE IMPACT ON WHOLESALE AND RETAIL TRADE, RESTRAINTS AND HOTELS, 1965-85

Impact of government consumption				
(1) *DIST* =	− 1.44 *INFE*	+ 4.46 *INFU*	+ 1.82 *YNOE*	+ 1.52 *YNOU*
	(− 1.83)	(2.66)	(5.10)	(4.34)
	− 0.28 *GCE*	− 0.18 *GCU*	+ 0.35 *RHO*	
	(− 0.63)	(− 0.76)	(1.70)	
			$r2 = 0.993$; $F = 319.77$; $D = 2.17$	
Impact of government investment				
(2) *DIST* =	− 1.71 *INFE*	+ 4.34 *INFU*	+ 1.66 *YNOE*	+ 1.49 *YNOU*
	(− 1.58)	(2.78)	(10.32)	(6.59)
	+ 0.11 *GIE*	− 0.40 *GIU*	+ 0.44 *RHO*	
	(0.45)	(− 1.15)	(2.18)	
			$r2 = 0.993$; $F = 315.08$; $D = 1.90$	
Impact of defense expenditures				
(3) *DIST* =	− 1.27 *INFE*	+ 4.02 *INFU*	+ 1.60 *YNOE*	+ 1.36 *YNOU*
	(− 1.60)	(2.27)	(7.65)	(4.78)
	− 0.13 *MEE*	+ 0.17 *MEU*	+ 0.37 *RHO*	
	(− 0.47)	(0.60)	(0.34)	
			$r2 = 0.993$; $F = 302.21$; $D = 2.13$	
Impact of total government expenditures				
(4) *DIST* =	− 1.46 *INFE*	+ 3.45 *INFU*	+ 1.57 *YNOU*	+ 1.33 *YNOE*
	(− 1.59)	(1.92)	(8.18)	(4.89)
	+ 0.08 *GEE*	− 0.02 *GEU*	+ 0.36 *RHO*	
	(0.38)	(− 0.11)	(1.75)	
			$r2 = 0.993$; $F = 313.04$; $D = 2.09$	
Impact of private consumption and commercial bank credit				
(5) *DIST* =	0.09 *INFE*	+ 4.01 *INFU*	+ 1.00 *CBCRP*	+ 1.07 *YNOE*
	(0.13)	(3.53)	(2.55)	(4.32)
	+ 0.85 *YNOU*	− 0.03 *PCE*	− 0.28 *PCU*	+ 0.37 *RHO*
	(3.49)	(− 0.12)	(− 1.63)	(1.79)
			$r2 = 0.997$; $F = 537.13$; $D = 1.86$	

Notes: Estimates were made using a Cochrane-Orcutt iterative estimation procedure to correct for serial correlation. $r2$ = coefficient of determination; $F = F$ statistic; DW = Durbin Watson Statistic; ( ) = t statistic

TABLE 6

SAUDI ARABIA: EXPENDITURE IMPACT ON TRANSPORT, STORAGE, COMMUNICATIONS, 1965-85

Impact of government consumption				
(1) *TSC* =	− 4.64 *INFE*	− 5.06 *INFU*	+ 2.93 *YNOE*	+ 2.13 *YNOU*
	(− 4.14)	(− 2.33)	(6.16)	(4.76)
	− 1.73 *GCE*	− 0.58 *GCU*	+ 0.50 *RHO*	
	(− 2.96)	(− 1.97)	(2.61)	
			$r2 = 0.969$; $F = 68.38$; $D = 1.77$	
Impact of government investment				
(2) *TSC* =	− 6.65 *INFE*	− 6.27 *INFU*	+ 1.91 *YNOE*	+ 1.02 *YNOU*
	(− 4.18)	(− 5.75)	(7.93)	(3.17)
	+ 0.88 *GIE*	+ 1.64 *GIU*	+ 0.18 *RHO*	
	(2.39)	(3.34)	(2.82)	
			$r2 = 0.968$; $F = 66.47$; $D = 1.86$	
Impact of defense expenditures				
(3) *TSC* =	− 4.52 *INFE*	− 7.69 *INFU*	+ 2.03 *YNOE*	+ 1.56 *YNOU*
	(− 2.79)	(− 2.91)	(5.23)	(3.57)
	− 0.31 *MEE*	− 0.29 *MEU*	+ 0.71 *RHO*	
	(− 0.70)	(− 0.69)	(4.54)	
			$r2 = 0.903$; $F = 20.27$; $D = 1.63$	
Impact of total government expenditures				
(4) *TSC* =	− 4.01 *INFE*	− 7.97 *INFU*	+ 1.88 *YNOE*	+ 1.31 *YNOU*
	(− 2.41)	(− 2.88)	(5.41)	(3.13)
	− 0.18 *GEE*	+ 0.06 *GEU*	+ 0.65 *RHO*	
	(− 0.52)	(0.26)	(1.75)	
			$r2 = 0.927$; $F = 27.62$; $D = 1.41$	
Impact of private consumption and commercial bank credit				
(5) *TSC* =	− 4.27 *INFE*	− 7.29 *INFU*	+ 0.54 *CBCRP*	+ 1.26 *YNOE*
	(− 2.77)	(− 5.20)	(0.78)	(2.46)
	+ 0.91 *YNOU*	− 0.34 *PCE*	− 0.74 *PCU*	+ 0.80 *RHO*
	(1.92)	(0.78)	(2.10)	(5.96)
			$r2 = 0.917$; $F = 19.02$; $DW = 1.79$	

Notes: Estimates were made using a Cochrane-Orcutt iterative estimation procedure to correct for serial correlation. $r2$ = coefficient of determination; $F = F$ statistic; DW = Durbin Watson Statistic; ( ) = t statistic

internationally, Dutch Disease effects are most likely diverting resources to other (non-traded) activities in the kingdom.

2. As with manufacturing, spread effects are considerably more important in affecting output than the direct linkage effects associated with increased government expenditures. However, military expenditures are the only apparent source causing a crowding out of resources from the sector.

3. Credit, but not private consumption have aided agriculture's rather phenomenal growth.

In contrast to the traded activities examined above, non-traded sectors follow a somewhat different pattern:

1. Construction (Table 4) has been largely stimulated by government investment and inflation. This is consistent with the non-traded character of the sector and the direct link of sectoral activity with the government's infrastructure programs.

2. Trade (Table 5) has been largely linked to activity in other sectors – spread effects are predominant. While inflation might be expected to have drawn resources towards the sector, this appears to be only true in the case of unanticipated inflation.

3. Transport, Storage and Communication sectors have experienced (Table 6) a blend of factors responsible for the expansion of the construction and trade sectors. Inflation has drawn resources towards these activities as their profitability most likely increased relative to traded activities. While the direct links to government investment have been important, spread effects have been particularly strong elements affecting this sector's output.

Conclusions

The main thrust of the analysis undertaken above has been to assess the possibility of reduced government expenditures as a way of overcoming the deflationary effects associated with falling oil revenues and the need for sustained austerity in public sector expenditures. Particular attention has been given to the ability of the government to sustain manufacturing output

through altering the composition (but not necessarily level) of public sector expenditures.

With regard to the government's infrastructure program, one can only conclude that the Saudi Arabian development strategy, based largely on the assumptions of a Hirschman type unbalanced growth strategy greatly overestimated the willingness of entrepreneurs to shift resources to manufacturing as costs of production fell. Put differently the Saudi Arabian private sector does not appear interested in investing in fixed plant and equipment solely as a result of the Hirschman-type cost reducing linkages stemming from the public sector's infrastructure led development strategy.

On the other hand, the demand creation or spread effects stemming from the government's infrastructure led investment program has been successful in creating a non-inflationary environment, which in turn has tended to stem the potential flow of resources out of the sector and into non-traded activities.

Clearly, private sector demand still remains to a certain extent a function of government expenditure.

It appears however [17] that private sector demand is likely to remain reasonably buoyant even with lower government expenditures because a significant portion of the demand is financed by past savings. This seems to confirm the more optimistic observations of certain Gulf officials that the fall in oil revenues and in government expenditure may have set in motion some degree of cure for any Dutch Disease problems that remain.

As the Economist Intelligence Unit notes: [18]

> It is something of a truism to say that private capital steers clear of inflationary situations, but it may yet come to have considerably more relevance in the Gulf than in any sophistry involved in breaking oil revenue into component income and capital parts. With the easing of the governments pull on the availability of manpower, services and goods, and with a greater emphasis on efficiency in both the oil and government sectors, the costs of doing business have fallen, and the returns have become more predictable.

The results presented above are consistent with the Intelligence Unit's assessment that the willingness of the Gulf private sector to repatriate incremental income derived from past government spending, or to liquidate foreign currency deposits held in local banks to finance investment in industry or even to fund certain government projects will be crucial over the next few years. The private sector needs reassurance that the government will not engage in policies likely to initiate another round of inflation.

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[17] Looney (1987/88).

[18] Economist Intelligence Unit (1988a, p. 17).

In terms of government expenditures themselves, the results presented above suggest that all efforts should be made to shift allocations from consumption to the Saudi Industrial Development Bank. In this sense the recent decline in government sponsored lending activity (Table 1) must be reversed if industrial output is to sustain another phase of expansion.

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EFFICACIA DEGLI SFORZI DI DIVERSIFICAZIONE INDUSTRIALE DELL'ARABIA SAUDITA: CONSEGUENZE DI UNA DIMINUZIONE DELLE SPESE PUBBLICHE

Scopo principale di questo articolo è di esaminare le conseguenze della riduzione dei ricavi petroliferi per l'economia dell'Arabia Saudita. In particolare, l'articolo esamina varie strategie di austerità alternative che si aprono al governo.

I principali risultati sono che il programma del governo di investimenti in infrastrutture si è rivelato deludente nello stimolare l'investimento del settore privato. D'altra parte, la creazione di domanda o gli effetti collaterali originati dal programma di investimenti in infrastrutture ha avuto successo nel creare un ambiente non inflazionistico. Questo a sua volta ha avuto la tendenza a dirigere il flusso potenziale di risorse fuori da questo settore. Evidentemente, la domanda del settore privato rimane ancora in certa misura una funzione della spesa pubblica.

In termini di spese pubbliche, i risultati qui presentati suggeriscono che si dovrebbero intensificare gli sforzi per spostare le disponibilità dal consumo verso la Banca per lo Sviluppo Industriale dell'Arabia Saudita.

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FEDERAL GOVERNMENT BORROWING AND NEW HOME MORTAGE RATES IN THE UNITED STATES: AN EMPIRICAL NOTE

by
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I. *Introduction*

In recent years, a number of studies have examined the impact of federal government budget deficits upon interest rates in the United States (cf. Barth, Iden, and Russek, 1984, 1985; Evans, 1985, 1987a, 1987b; Cebula, 1987; Feldstein and Eckstein, 1970; Hoelscher, 1983; Makin, 1983; Mascaro and Meltzer, 1983; McMillin, 1986; Mishkin, 1981; Motley, 1983; and Zahid, 1988). This literature has focused principally upon the interest rate yield on three month Treasury bills, although various other interest rate measures (such as the commercial paper rate, the ten year Treasury note rate, the 20-year Treasury bond rate, and the Moody's Aaa-rated corporate bond rate) have been examined as well. With few exceptions (cf. Barth, Iden, and Russek, 1984, 1985; Cebula, 1987; and Zahid, 1988), most of these empirical studies have found that federal budget deficits do not significantly influence interest rate levels in the United States.

One interest rate measure that has been altogether overlooked in this literature is the interest rate yield on new home mortgages. Since this relatively long-term interest rate may significantly affect housing demand (the "real" sector of the economy), it may be useful to ascertain whether this interest rate level is influenced by the federal deficit. Accordingly, using a simple loanable-funds model, this study empirically examines the effects of

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federal budget deficits upon the nominal interest rate yield on new home mortgages.

II. *A Simple Loanable Funds Model*

Our model treats the nominal long-term interest rate as being determined by a loanable funds equilibrium of the following form:

$$D - S = B - M \tag{1}$$

where D = real domestic private sector long-term bond demand

S = real domestic private sector long-term bond supply

M = real purchases of securities by the Federal Reserve System

B = real borrowing by the United States Treasury

The assumed behavioral relationships are:

$$D = D(R, P, RSR),\ D_R > 0,\ D_P < 0,\ D_{RSR} < 0 \tag{2}$$

$$S = S(R, P, RSR),\ S_R < 0,\ S_P > 0,\ S_{RSR} > 0 \tag{3}$$

where R = the nominal long-term rate of interest

P = the expected future inflation rate

RSR = the expected real short-term interest rate

Based upon the standard loanable funds model, bond demand is an increasing function of the nominal interest rate and a decreasing function of expected inflation. Following Hoelscher (1986), it also is argued that the higher the expected real short-term rate of interest, the smaller the demand for longer-term bonds: as RSR rises, investors substitute short-term bonds for long-term bonds in their portfolios.

Based on the standard loanable funds model, bond supply is a decreasing function of the nominal interest rate and an increasing function of expected inflation. Following Hoelscher (1986), it is also hypothesized that the greater the expected real short-term interest rate, the greater the incentive for bond suppliers to issue long-term bonds in lieu of short-term bonds. This is because as RSR rises, short-term borrowing becomes relatively more costly and thus longer-term borrowing becomes relatively more attractive.

Substituting (2) and (3) into (1) and solving for R yields:

$$R = R\,(P,\ RSR,\ B,\ M) \tag{4}$$

The expected signs on the partial derivatives are

$$R_P > 0,\ R_{RSR} > 0,\ R_B > 0,\ R_M < 0 \tag{5}$$

The first two signs are based upon (2) and (3). Next, based on conventional macroeconomics, interest rates are expected to be an increasing function of B and a decreasing function of M.

Although this paper resembles other related studies in its focus upon the federal budget deficit, it differs from these studies in its specification of the deficit. Specifically, it is commonplace in the literature to measure the deficit as simply the difference between aggregate federal outlay and receipts. By contrast, when examining the interest-rate impact of the deficit, we distinguish expressly between the *cyclical deficit* (*CD*), which is the countercyclically *endogenous* component of the total deficit, and the *structural deficit* (*SD*), which approximates the *exogenous* component of the total deficit. With the federal deficit decomposed thusly, the next section of this note includes both *CD* and *SD* and (of necessity) estimates equations by *2SLS*.

Given the observations above, the term B in equation (4) is replaced by *CD* plus *SD*. Accordingly, the model becomes:

$$R = R\,(P,\ RSR,\ CD,\ SD,\ M) \tag{6}$$

where it is expected that:

$$R_P > 0,\ R_{RSR} > 0,\ R_{CD} > 0,\ R_{SD} > 0,\ R_M < 0 \tag{7}$$

III. *Empirical Analysis*

Based upon the model in (6) and (7), the first equation we examine is given by:

$$R_t = a_0 + a_1 P_t + a_2 RSR_t + a_3 CD_t/Y_t + a_4 SD_t/Y_t + a_5 M_t/Y_t + u_1 \tag{8}$$

where Y = the seasonally adjusted middle-expansion trend *GNP*.The model is quarterly and covers the 30-years period from 1955:1 through 1984:4. The subscript "t" refers to quarter "t". We begin with 1955:1 since this is the first quarter for which structural deficit data are available (see Holloway, 1986). We end with 1984:4 due to data limitations with respect to expected inflation after that time (see Thies, 1986).

The variable R_t is the nominal average interest rate yield in quarter t on new home mortgages, expressed as a percent per annum. These interest rate data were obtained from the *Economic Report of the President.* The inflationary expectations variable (P_t) is based upon a recent study by Thies (1986), who derives inflationary expectations data on a monthly basis. These data are potentially more useful than the Livingston survey data which, while otherwise similar to the data in Thies (1986), are either semi-annual or annual in nature and thus are less neatly adapted to a quarterly framework. These inflationary expectations data are available through the end of 1984. The variable P_t represents the average expected inflation rate in quarter t, expressed as a percent per annum.

The variable RSR_t represents the ex ante real three-month Treasury bill rate in quarter t, expressed as a percent per annum. RSR_t is computed by subtracting the average expected inflation rate in quarter t from the nominal average interest rate yield on three-month Treasury bills in quarter t (which is also expressed as a percent per annum). The data on the three-month Treasury bill rate are obtained from the *Economic Report of the President.*

As shown in equation (8), the analysis includes measures of both the structural deficit and the cyclical deficit. The structural deficit data are based upon a recent study by Holloway (1986, Table 3), who provides revised and updated quarterly estimates of the seasonally adjusted structural surplus for the period beginning 1955:1. To convert these data into structural *deficit* data, it was necessary to multiply the series by (– 1). The seasonally adjusted cyclical deficit is simply the difference between the seasonally adjusted total federal deficit and the seasonally adjusted structural deficit. The deficit data are all expressed in billions of current dollars.

As shown in equation (8), the analysis also includes the variable M_t, which is used to reflect monetary policy (as described in Section II above). Following Barth, Iden and Russek (1985) and Hoelscher (1983), M_t is computed by averaging the seasonally adjusted current-quarter and preceding-quarter values of the net acquisition of credit market instruments by the Federal Reserve System. This two-quarter moving average is adopted in order to allow adequate time for changes in the monetary base to influence banking system liquidity and hence the supply of loanable funds in the economy. These data are expressed in billions of current dollars and were obtained from the *Flow of Funds Accounts* of the Federal Reserve System.

One additional and important observation is now in order. Specifically, in principle following earlier studies by Barth, Iden and Russel (1984), Holloway (1986), Hoelscher (1983), Cebula (1987), and Evans (1985; 1987a; 1987b), the variables SD_t, CD_t, and M_t are all divided by the

seasonally adjusted middle-expansion trend GNP in quarter t (which is also expressed in billions of current dollars) and then expressed as a percent per annum. This procedure of dividing these variables by trend GNP is adopted because open market operations and both measures of the deficit should all be judged relative to the size of the economy. The trend GNP data are obtained from Holloway (1986, Table 2).

Naturally, with the cyclical deficit included in the analysis, there arises the possibility of simultaneous-equation bias. This is because the cyclical deficit, by its very nature, is endogenous. Accordingly, equation (8) is estimated using an instrumental variables technique (as well as the Cochrane-Orcutt technique to correct for serial correlation), with the instrument being the seasonally adjusted quarterly unemployment rate of the civilian labor force (lagged one quarter). The choice of instrument is based upon the fact that the lagged unemployment rate of the civilian labor force systematically explains the cyclical deficit, whereas the contemporaneous error terms in the system are not correlated with the lagged unemployment rate [1].

The 2SLS estimate of equation (8) is given by:

$$(9) \quad R_t = 3.78 + \underset{(+\ 12.78)}{0.726}\ P_t + \underset{(+\ 12.35)}{0.608}\ RSR_t + \underset{(+\ 7.47)}{0.931}\ CD_t/Y_t$$

$$+ \underset{(+\ 6.13)}{0.434}\ SD_t/Y_t - \underset{(-\ 0.78)}{0.664}\ M_t/Y_t,\ DF = 113,\ DW = 1.76,\ Rho = 0.12$$

where terms in parentheses are t-values.

As shown in equation (9), all five of the estimated coefficients exhibit the hypothesized signs. In addition, four of the five estimated coefficients are statistically significant at far beyond the one percent level. Only the coefficient on M_t/Y_t fails to be significant at an acceptable level.

Based upon equation (9), it appears that the federal budget deficit exercises a positive and statistically significant impact upon the nominal new home mortgage rate [2]. Other specifications of the model yield this same conclusion. For example, replacing the terms CD_t/Y_t and SD_t/Y_t

[1] In addition, the *total* federal budget deficit is partly endogenous. Hence, its inclusion in the analysis also raises the possibility of simultaneous-equation bias. As a result, whenever the total deficit appears in the analysis, we estimate the equation involved using an instrumental variables technique (as well as the Cochrane-Orcutt procedure to correct for serial correlation), with the instrument being the seasonally adjusted quarterly unemployment rate of the civilian labor force, lagged one quarter.

[2] Results very similar to those reported in equation (9) are obtained for other time periods. For example, for the period 1973:1 – 1984:4, the *2SLS* results are:

in equation (8) by the single term TD_t/Y_t, where TD_t is the seasonally adjusted *total* federal budget deficit in quarter t expressed in billion of current dollars, yields the following structural equation:

$$(10) \qquad R_t = b_0 + b_1 P_t + b_2 RSR_t + b_3 TD_t/Y_t + b_4 M_t/Y_t + u_2$$

Estimating equation (10) by *2SLS* in precisely the same fashion that equation (8) was estimated yields:

$$(11) \qquad R_t = \underset{}{4.067} + \underset{(+\ 9.93)}{0.675}\ P_t + \underset{(+\ 8.58)}{0.496}\ RSR_t + \underset{(+\ 7.71)}{0.741}\ TD_t/Y_t$$

$$- \underset{(-\ 1.83)}{1.923}\ M_t/Y_t,\ DF = 114,\ DW = 1.82,\ Rho = 0.11$$

As shown in equation (11), the coefficient on variable TD_t/Y_t is positive and statistically significant at well beyond the one percent level. Thus, we once again find that the federal budget deficit exercises a positive and significant impact upon the nominal new home mortgage rate [3].

Alternatively, consider the following specifications of our basic model:

$$(12) \qquad R_t = c_0 + c_1 P_t + c_2 RSR_t + c_3 CD_t^* + c_4 SD_t^* + c_5 M_t^* + u_3$$

$$(13) \qquad R_t = d_0 + d_1 P_t + d_2 RSR_t + d_3 TD_t^* + d_4 M_t^* + u_4$$

where the asterisks adjacent to the variables CD_t, SD_t, M_t, and TD_t indicate that the variables in question are expressed in billions of 1982 dollars.

Estimating equations (12) and (13) by *2SLS* in precisely the same

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$$R_t = \underset{}{5.12} + \underset{(+\ 3.84)}{0.517}\ P_t + \underset{(+\ 7.45)}{0.556}\ RSR_t + \underset{(+\ 3.26)}{0.92}\ CD_t/y_t + \underset{(+\ 2.84)}{0.433}\ SD_t/Y_t$$

$$- \underset{(-\ 0.52)}{0.888}\ M_t/Y_t,\ DF = 41,\ DW = 1.77,\ Rho = 0.14$$

Here, as in equation (9), the deficit variables are positive and significant at beyond the one percent level.

[3] For the period 1973:1 – 1984:4, the results from estimating (10) by *2SLS* are:

$$R_t = \underset{}{4.49} + \underset{(+\ 3.75)}{0.537}\ P_t + \underset{(+\ 6.98)}{0.542}\ RSR_t + \underset{(+\ 4.03)}{0.682}\ TD_t/Y_t - \underset{(-\ 1.85)}{2.05}\ M_t/Y_t,$$

$$DF = 42,\ DW = 1.80,\ Rho = 0.13$$

Clearly, these results are entirely consistent with those in equation (11).

fashion that equations (8) and (10) were estimated yields (14) and (15), respectively:

$$(14) \quad R_t = 3.916 + 0.721\ P_t + 0.529\ RSR_t + 0.031\ CD_t^* \\ (+\ 13.20) \quad (+\ 11.39) \quad (+\ 6.62)$$

$$+ 0.016\ SD_t^* - 0.037\ M_t^*,\ DF = 113,\ DW = 1.75,\ Rho = 0.12 \\ (+\ 6.77) \quad (-\ 1.26)$$

$$R_t = 4.275 + 0.691\ P_t + 0.386\ RSR_t + 0.024\ TD_t^* - 0.029\ M_t^*, \\ (15) \quad (+\ 10.25) \quad (+\ 6.89) \quad (+\ 7.63) \quad (-\ 0.87)$$

$$DF = 114,\ DW = 1.73,\ Rho = 0.13$$

As shown in equation (14) and (15), we once again observe that the coefficients on the various deficit variables are all positive and statistically significant at far beyond the one percent level. Thus, we have yet more evidence indicating that federal budget deficits raise the nominal new home mortgage rate in the United States [4].

IV. *Concluding Remarks*

Based upon a simple loanable funds model, this paper has estimated a variety of structural equations using quarterly data for the period 1955:1 through 1984:4. In all cases, it was found that federal budget deficits exercise a positive and significant impact upon the nominal new home

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[4] Results consistent with those shown in equations (14) and (15) are obtained for the period 1973:1 – 1984:4. This fact is illustrated by the following *2SLS* estimates of (12) and (13), respectively:

$$R_t = 5.04 + 0.545\ P_t + 0.519\ RSR_t + 0.028\ CD_t^* + 0.015\ SD_t^* \\ (+\ 4.17) \quad (+\ 7.27) \quad (+\ 3.26) \quad (+\ 3.32)$$

$$- 0.032\ M_t^*,\ DF = 41,\ DW = 1.78,\ Rho = 0.15 \\ (-\ 0.62)$$

and

$$R_t = 5.00 + 0.52\ P_t + 0.462\ RSR_t + 0.02\ TD_t^* - 0.065\ M_t^*, \\ (+\ 3.58) \quad (+\ 6.01) \quad (+\ 3.84) \quad (-\ 1.27)$$

$$DF = 42,\ DW = 1.72,\ Rho = 0.17$$

mortgage rate. This finding is in principle at odds with most of the existing literature, but consistent with studies of the three month Treasury bill rate by Barth, Iden, and Russek (1984; 1985), Cebula (1987), and Zahid (1988).

Moreover, it can also be shown that empirical estimates based on the *IS-LM* model yield the same conclusion: namely, budget deficits raise the nominal new home mortgage rate. To illustrate we begin by observing that the *IS-LM* paradigm is extremely familiar to economists. Accordingly, we need not formally derive its implications here. Rather, it is simply asserted that, according to the conventional *IS-LM* model, the nominal rate of interest is principally determined by the level of real government spending, the real deficit, the real money stock, and the expected inflation rate.

Based upon this simple *IS-LM* model, we estimate the following equation:

$$(16)\quad R_t = e_0 + e_1 G_t^* + e_2 TD_t^* + e_3 M_t^* + e_4 P_t^* + u_5$$

where: G_t^* = the seasonally adjusted federal government purchases of goods and services in quarter t, expressed in billions of 1982 dollars [5].

Estimating equation (16) by *2SLS* in precisely the same fashion as (8), (10), (12), and (13) were estimated, yields:

$$(17)\quad R_t = \underset{}{0.968} + \underset{(+\,3.80)}{0.024}\ G_t^* + \underset{(+\,2.75)}{0.011}\ TD_t^* - \underset{(-\,1.85)}{0.015}\ M_t^* + \underset{(+\,5.90)}{0.605}\ P_t,$$

$$DF = 114,\ DW = 1.61,\ Rho = 0.20$$

In this estimation, the deficit variable once again is positive and statistically significant at beyond the one percent level.

Clearly, the empirical results presented in this paper have important implications. For example, to the extent that interest rates are higher in the United States than otherwise would be the case, the probability of "Third World" debt crises is elevated (c.f. Errunza and Ghalbouni, 1986). In addition, the evidence would also imply the existence of *crowding-out of private housing demand* (as a result of the budget deficit), which presents a variety of short-run and long-run adverse economic consequences for the United States. In turn, these consequences may impact indirectly upon the economic well-being of those nations economically inter-related with the United States. Furthermore, it appears that the results provided here imply

[5] The term G_t^* excludes all transfer payments.

the existence of an actual mechanism for the transmission of crowding out and also instill a renewed faith in the usefulness of standard macro-models such as the loanable funds model and the *IS-LM* model.

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DEBITI DEL GOVERNO FEDERALE E TASSI SUI MUTUI IPOTECARI PER LE NUOVE CASE NEGLI STATI UNITI: UN NOTA EMPIRICA

Questo articolo esamina gli effetti del deficit del governo federale sui tassi ipotecari per le nuove case negli Stati Uniti. Questo è un argomento quasi completamente ignorato nella letteratura. L'articolo sviluppa un modello per determinare il tasso d'interesse dei fondi mutuabili. Quindi, l'articolo esamina empiricamente gli effetti del deficit sia strutturale sia ciclico sul tasso nominale dei mutui ipotecari. Per il periodo 1955-1985 una stima con i minimi quadrati a due stadi rivela che entrambe le misure del deficit aumentano il tasso sui mutui. Con un'altra stima con i minimi quadrati a due stadi, si mostra che anche il deficit totale aumenta il tasso ipotecario.

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ECONOMIC INTEGRATION AND DEVELOPMENT: THE EXPERIENCE OF A NEWLY INDUSTRIALISING ECONOMY (GREECE 1981-1987).

by
TASSOS GIANNITSIS *

The accession of Greece to the European Community (EC) implied profound and structural changes in the economic environment of the country (e.g. competition rules, protection level, agricultural policy, external relations etc.) and has already caused important changes in the fundamental relations of two major sectors of its economy: agriculture and industry. The most apparent integration effects during the first eight years are the "trade effects". However, the appearance of profound changes in basic relationships and in particular, the slow but steady weakening of its industrial base seem to indicate that "structural effects" have also been exerted, with significant impacts on its development perspectives.

Trade flows exhibited significant shifts after accession (1981). The most striking feature was the increase of the EC's weight in Greece's imports. The Community's share in non-oil imports jumped from 54.5% (average 1978-80) before accession to 61.2% in 1981 and further increased to 69.1% (1986). The participation of the EC in agricultural imports increased from 34% (1976-80) to 77.4% in 1981-86, while for industrial imports the respective figures were 67.6% and 70.7% [1].

In fact, apart from these important changes in market shares between groups of countries, which could be interpreted as trade creation effects, there has also been an important expansion of trade and particularly for industrial goods. Imports of industrial consumer goods from the EC as a

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This paper is based on a broader research conducted at the Foundation of Mediterranean Studies (Athens) on the effects of the accession of Greece into the European Community.

[1] See MARAVEYAS (to be published); GEORGACOPOULOS (1986); LIODAKIS (1985). For international bibliography see FELS (1988) and AXT (1987).

percentage of the GDP of manufacturing increased from 29.8% (1976-80) to 41.8% (1981-86). The respective figure for third countries was 14.5% and 15.7% [2], and is indicative of the importance of EC countries as the main origin of the increased imports.

The present paper will concentrate on trade in manufacturing goods and its impact on the competitive position of this sector during the years 1981-86. The experience of Greece is of more general interest, because it is perhaps one of the very rare newly industrialising economies which liberalised its trade and opened its economy to world market competition at a much earlier phase of industrial development than most NIE's.

The analysis focused on a) industry as a whole, b) three distinct broader groups of branches: "traditional" (mostly consumer) goods, intermediate goods and capital goods [3], and c) the 20 two-digit branches of manufacturing activity (hereafter referred to as industry).

The disaggregation by branches permits the identification of instances of trade effects in individual industries, which otherwise would be masked in the aggregate results. On the other side, the aggregation by groups of industries is based on the argument that integration has different effects on the various sectors of Greek industry for at least two reasons:

The first concerns the different levels of strength or weakness of the various activities vis-a-vis imports. Traditional industries with accumulated experience, productive potential knowledge of the market, easy access to technologies and wage cost advantages are in a better position to cope with international competition than technologically complex industries, which face various constraints affecting their possibilities to be competitive.

The second reason for this distinction is the different degree of exposure of the various industries after accession according to the degree of protection which had to be abolished. The transition from pre-accession conditions to the Community's rules of the game implied a significant decrease of protection mostly for the "traditional" consumer goods industries, which were the most protected before 1981 (see below). It is reasonable therefore to expect different effects on industrial activities as a function of the different changes in their operating conditions.

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[2] Similar results are obtained if the comparison is made with total GDP instead of manufacture.

[3] These groups comprise the following branches: *a*) traditional industries: food, drinks, tobacco, textiles, footwear-apparel, wood-cork, furniture, paper, printing, leather and the various industries; *b*) intermediate industries: rubber-plastics, chemicals, oil products and non metallic minerals; *c*) capital good industries: metallurgy, metal products, machinery, electrical machines material and transport means.

A further reason for the separate treatment of these groups of industries is the heavy dependence of the activity of capital goods industries on the level of investment. It is therefore useful to examine them separately since they are subject to different cyclical movements.

I. *Integration and the Structure of Protection*

Since the effects of accession on Greek industry are closely associated to the changes in its protection structures, a brief description will be made of the most relevant changes in protection, as a consequence of integration into the EC.

The two decisive changes determining the impact of integration into the EC on Greek industry were related to tariff and non-tariff protection and the obligation to apply equal treatment to domestic and imported goods. Both these changes had important implications for Greek industry, since they implied the transition from high trade barriers and discriminatory policies to a situation of intensified competition, freer access of imports to the domestic market, and the elimination of direct or indirect subsidies to industrial firms. It should be noted that import liberalisation did not only concern goods competing with domestic production. A broad range of other consumer goods with high value added (e.g. cars, electrical household appliances, luxury goods etc.), although not produced domestically, also faced high trade barriers imposed for balance of trade reasons.

Our attempt to estimate import duties (tariffs, taxes etc.) on imported goods by industrial branch shows that in a period of a few years, many industries experienced a considerable reduction of protection (see Table 1). In fact, the decrease in protection has been much more important than shown in Table 1, because a broad range of domestic activities have also benefited from high nontariff barriers, the effects of which are not captured by these data.

In view of this pattern of protection, the hypothesis can be put forward, that accession and the reduction of trade barriers should mostly affect those industries which previously benefited from relatively higher protection, i.e. traditional industries. Other industries have also been exposed to greater competition pressures but changes have not been so pronounced and concerned specific sub-activities within the broader groups of intermediate and capital goods industries.

Import liberalisation had five fundamental effects on industry:

TABLE 1

IMPORT DUTIES AS PERCENTAGE OF IMPORT VALUE

Branch	1974	1980	1986	1986/1974 % change	1986/80 % change
Food	30.0%	21.7%	8.4%	−72.0%	−61.3%
Drinks	184.5%	145.9%	116.2%	−37.0%	−20.4%
Tobacco	83.0%	9.6%	4.7%	−94.3%	−51.0%
Textiles	53.3%	38.7%	28.2%	−47.1%	−26.1%
Footwear	51.0%	27.8%	27.0%	−47.1%	−2.9%
Apparel	56.1%	49.1%	32.2%	−42.6%	−.34.4%
Wood-Cork	52.5%	36.9%	20.4%	−61.1%	−44.7%
Furniture	43.2%	33.3%	22.5%	−47.9%	−32.4%
Paper	26.0%	20.0%	16.7%	−35.8%	−16.5%
Leather	51.7%	46.0%	33.4%	−35.6%	−27.6%
Plastics-Rubber	43.2%	32.6%	26.2%	−39.4%	−19.6%
Chemicals	23.2%	20.0%	19.1%	−17.7%	−4.5%
Oil products	29.3%	19.6%	48.3%	+ 64.8%	+ 146.4%
Non metallic minerals	27.5%	29.4%	30.4%	+ 10.5%	+ 3.4%
Metallurgy	21.7%	26.1%	21.0%	−3.2%	−19.5%
Metal products	27.8%	25.2%	20.8%	−25.2%	−16.1%
Machinery	12.5%	11.6%	12.6%	+ 0.8%	+ 8.6%
Electrical appliances	23.8%	26.3%	42.7%	+ 79.4%	+ 62.4%
Transport means	27.3%	26.5%	70.5%	+ 158.2%	+ 166.0%
Various industries	32.4%	29.0%	27.2%	−16.0%	−6.2%

Source: GIANNITSIS (1988).

a) it significantly improved the conditions of market penetration of foreign products, mainly consumer or consumer durable goods,

b) it directly or indirectly squeezed the profit ratios of domestic industries,

c) it altered relative prices not only between comparable goods, but also between goods which are imported but not produced domestically and domestic products,

d) it eliminated any significant possibility of providing infant industry protection to newly establishing industrial activities, in a country where industrial development lagged far behind that of any other EC member, and

e) it mobilised the domestic firms which had the necessary experience, capacities and resources to modernise and to reorganise their functions in order to face competition.

Integration effects on prices, profits, infant industry protection, restructuring etc. are of strategic importance in explaning the internal dynamics of Greek economy during the 1980's [4]. However, as our analysis is focused on trade effects, we will try in the following to examine these effects as well as their implications for the relative market positions of the various industries.

II. *Effects of Accession on Greek Industry*

To estimate the trade effects on industry, we used the following approach:

Firstly, we examined changes in the shares of domestic, EC and third country producers in domestic apparent consumption as well as changes in the overall position of Greek industries during the years after 1981.

Secondly, on the basis of approaches developed for similar analyses [5] concerning the trade effects caused by the formation of the EEC, EFTA etc., we estimated the extent of trade effects and their importance for individual industries.

a) Changes in shares and in the competitive position of domestic industries. The competitive position of industries and the respective market shares have been estimated with the help of an index d taking the form [6]:

$$d_i = 1 + x_i - m_i$$

The index d is equal to $Q/(Q + M - X)$ (i.e. domestic production to apparent domestic consumption), where:

Q = domestic production (gross value)
M = imports
X = exports
i = industrial branch

Since $Q - X + M$ equals domestic demand (D), it follows that $Q = D + X - M$. Therefore: $d = Q/D$ which is $[D + X - M]/D$ and

$$d = 1 + x - m$$

where $x = X/D$
$m = M/D$

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[4] For a detailed analysis see GIANNITSIS (1988, ch. 8-11).
[5] See TRUMAN (1969, 1972); EFTA (1972, p. 8ff).
[6] See LAFAY (1979, p. 20ff).

Index d permits us to calculate the shares of domestic producers ($d - x$) as well as those of the EC and third countries in domestic apparent consumption [7]. At the same time it can be used as an index of the international competitiveness of industries. This index was preferred to other relationships (such as the level of imports, import propensity etc.), because it permits us to estimate the overall performance of an industry, on the basis not only of import penetration, but also of its export activity and its respective position in the domestic market. It could be argued that since accession has not changed the conditions of entry of Greek products into EC markets, changes in export performance should not be taken into account, because they cannot be attributed to accession.

However, since integration implies an intensification of international specialisation of a country, increased import penetration can be offset by similar increases in export intensity, which can be the result of the indirect influences of integration [8]. The examination of export performance also indicates whether the deterioration of the overall competitive position of industry as expressed by d is effectively caused by import penetration or by export deterioration. In this last case it would be realistic to assume that factors other than integration (e.g. cost factors, domestic macroeconomic policies etc.) have negatively affected the international competitiveness of the country and that integration is not the main determinant factor of the deterioration of d [9].

Market shares have been considered as a more accurate variable than crude data on imports. Despite all the criticism which can be made, the use of market shares permits the elimination of cyclical influences to some extent; if averages over longer time periods are used instead of isolated years, they also permit the reduction of abnormal annual deviations. This is partly because in the absence of other major changes in the economy, shares display some degree of stability over time, but also because the use of shares automatically normalises changes in other variables (e.g. income). Changes in market shares can therefore be useful indicators of the type of trade

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[7] The importance of the EC and third countries can be captured either by distinguishing x and m in the equation, according to the two country groups or by estimating separately an index $d1 = 1 + x1 - m1$ and $d2 = 1 + x2 - m2$, where $x1$ and $m1$ are for EEC and $x2$ and $m2$ for third countries.

[8] Some possible reasons of increased export propensity because of the integration are explained in GIANNITSIS (1988, p. 84ff).

[9] The necessity of a parallel examination of exports and imports appears particularly in cases such as food, steel etc., the export performance of which is directly affected by the Community policies (CAP, steel policy).

effects taking place, to the extent of course that they can be theoretically explained as being the result of integration.

The interpretation of the connection between changes in market shares and trade effects has been made on the basis of the following classification scheme [10].

Patterns of share changes:	Sign of the share changes:		
	Domestic	Partners	Non-members
1. Double trade creation	−	+	+
2. Internal trade creation & external trade diversion	−	+	−
3. External trade creation & internal trade diversion	−	−	+
4. Double trade erosion	+	−	−
5. Internal trade erosion & internal trade diversion	+	−	+
6. External trade erosion & external trade diversion	+	+	−

b) Trade effects and their sectoral impact. The estimation of trade effects has been made by using the methodology developed by Truman in respect of the trade effects of the EC [11]. The accounting relationships underlying the computation of the various trade effects are outlined below. Each of these relationships has to be estimated for the domestic producers, EC and third country producers.

1) *Trade effect (substitution effect):* $C_t (S_t - S_0)$,

C = apparent consumption

S = participation of country group (EC, third countries, domestic producers) in domestic apparent consumption

t = 1981, 1982, ... 1986

0 = year to which the post-accession situation is compared

2) *Hypothetical demand:* $S_0 C_0 + S_0 (C_t - C_0) = S_0 C_t$.

This relationship consists of the supply in the base year ($S_0 C_0$) and the

[10] See TRUMAN (1969, p. 206).

[11] TRUMAN (1969, p. 212).

change in demand $[S_0 (C_t - C_0)]$, on the assumption that each group holds its share constant in the demand change. It shows us the total demand corresponding to each group (EC, third countries, domestic producers) after 1981, if each one holds its share constant at the level of the base year. 3) *The relationship between trade effects and hypothetical demand:* $C_t (S_t - S_0)$: $S_0 C_t$.

This relationship shows us the benefit (+) or the loss (–) of each group of countries as a result of integration with respect to the total demand which would correspond to it if its share in domestic consumption had remained at the level of the base year. A positive result indicates the existence of trade creation (for other member states or for third countries), while a negative result signifies the presence of trade diversion (or trade erosion in the case of member states).

One of the main problems of this approach is the selection of the base year (the *anti-monde*), with which the post-accession results will be compared. Because the results will vary according to the characteristics of the base year, alternative years or periods have been used (1978, 1979 and 1980) [12].

III. *The Empirical Results*

The competitive position of the Greek industrial branches and the market shares of the specific country groups have been calculated for the period 1968 to 1987. The annual results have been grouped into sub-periods (1968-73, 1974-77, 1978-80 and 1981-87). By doing this it is hoped to obtain a better view of the long – and shorter – term changes. Table 2 presents the results of the index *d*, which suggest that:

a) At the level of industry as a whole we notice a deterioration of the position in the post-accession, as opposed to previous periods. It is interesting to note that although the years 1974-80 coincide with a crisis and an increasing opening of Greek industry to the world market, they were associated with an improved position for industry (although with lower growth rates), since import penetration decreased and export intensity increased.

b) At the level of the three groups, i.e. traditional, intermediate and capital goods industries, we see that it is the first two which were mainly affected during the period after 1981. In contrast, there was an improvement of *d* in respect of the capital good industries [13].

[12] Calculations have been made also with previous years as *anti-mondes* (1974, 1977), but are not presented here.

[13] This improvement is due mainly to the decreasing investment and not to any substantial improvement of the productive capabilities of capital good industries.

c) At the level of the two-digit branches there was a deterioration in 15 of the 20 branches. These 15 branches concern more than 2/3 of total manufacturing value added. If the performance of the other five branches is considered not on the basis of the time-period averages but on an annual basis (not presented here), we see that with the exception of footwear-apparel and printing they also experienced a deterioration after 1983-4, leaving them in a worse position than in 1974-77.

In fact, for some branches (drinks, tobacco, wood, furniture, plastics-rubber and machinery) this deterioration reflects a negative trend which had already appeared before 1981. However, after 1981 the deterioration was more serious and extended to nearly all branches.

A closer examination of the above results indicate that for industry as a whole, domestic producers suffered losses of about 5 percentage points of their market share during the period 1981-87. For traditional industries these losses were of a much greater magnitude (10 percentage points). Radical shifts took place immediately in the first year of accession, while the comparison between 1987 and 1980 (or some previous year) suggests a much more dramatic decline than the average figures of the time-periods used in Tables 2 and 3.

Since the index d is determined by the import penetration and the export propensity of the country and the domestic sales, we examined which of these two factors determined the above changes. For this purpose x and m are presented separately for the same activities and periods (Table 3).

The examination of these two partial factors suggests the following:

a) the export performance of industry as a whole exhibited a continual improvement before and after accession. Exports as a percentage of domestic apparent consumption (x) grew from 10.1% in 1968-73 to 15.8% in 1974-77 and subsequently to about 18-19%. In the period after accession to the EC, total export intensity of industry remained stable (on average). However, there were important variations between the three groups of industries. Traditional industries exhibited an increasing export intensity before and after accession. In contrast, it was the fall in the intermediate industries which determined the stabilisation of x for total industry during the 1980's at the levels of the previous period.

b) The transition to accession was related to a generalised and abrupt increase of import penetration. Imports as a percentage of domestic apparent consumption increased in 16 branches and, as may be seen from Table 3, this deterioration was much more pronounced in the group of traditional industries. In many branches within this group, import penetration increased in a few years by growth rates of 287% (footwear-apparel,

TABLE 2

INDEX OF COMPETITIVENESS *d* BY INDUSTRIAL BRANCH (1968-87) *

Branches	1968-73	1974-77	1978-80	1981-87	Changes in %: 1974/77 1968/73	1978/80 1974/77	1981/7 1978/80
Food	0.992	1.046	1.094	1.053	5.4	4.6	−3.7
Beverages	1.092	1.086	1.065	1.034	−0.5	−1.9	−2.9
Tobacco	0.999	0.997	0.992	0.978	−0.2	−0.5	−1.4
Textiles	1.007	1.162	1.220	1.212	15.4	5.1	−0.7
Footwear-Apparel	1.135	1.283	1.188	1.373	13.1	−7.4	15.6
Wood	0.968	1.017	1.005	0.937	5.1	−1.2	−6.8
Furniture	0.960	0.988	0.967	0.892	2.9	−2.1	−7.8
Paper	0.663	0.613	0.940	0.733	−7.5	53.3	−22.0
Printing	0.974	0.967	0.955	0.972	−0.7	−1.2	1.8
Leather	1.025	1.145	1.179	1.019 **	11.7	3.0	−13.6 **
Elastic-Plastics	0.869	0.924	0.918	0.890	6.3	−0.6	−3.0
Chemical goods	0.583	0.649	0.667	0.597	11.3	2.8	−10.5
Refinery	0.944	1.063	1.261	1.093	12.6	18.6	−13.3
Non metallic minerals	0.942	1.175	1.142	1.170	24.7	−2.8	2.5
Metallurgy	0.983	1.007	0.984	0.984	2.4	−2.3	—
Metal products	0.759	0.902	0.868	0.837	18.8	−3.8	−3.6
Machinery	0.216	0.278	0.276	0.244	28.7	−0.7	−11.6
Electrical appliances	0.663	0.677	0.658	0.631	2.1	−2.8	−4.1
Transport means	0.450	0.508	0.485	0.494	12.9	−4.5	1.9
Various industries	0.292	0.404	0.309	0.301	38.4	−23.5	−2.6
Total	0.805	0.884	0.925	0.878	9.8	4.6	−5.1
Consumer goods	0.967	1.042	1.086	1.023	7.8	4.2	−5.8
Intermediate	0.782	0.890	0.970	0.884	13.8	9.0	−8.9
Capital goods	0.610	0.667	0.669	0.662	9.3	0.3	−1.0

* Based on annual averages of various periods.
** 1981-85.
Sources: See Table 1.

TABLE 3
EXPORTS (x) AND IMPORTS (m) TO DOMESTIC APPARENT CONSUMPTION

Industries	x				m			
	1968/73	1974/77	1978/80	1981/87	1968/73	1974/77	1978/80	1981/87
Food	0.120	0.159	0.187	0.241	0.128	0.113	0.093	0.188
Drinks	0.154	0.110	0.095	0.102	0.062	0.024	0.031	0.067
Tobacco	0.004	0.003	0.000	0.009	0.005	0.006	0.008	0.031
Textiles	0.116	0.264	0.314	0.416	0.110	0.101	0.094	0.204
Footwear-Apparel	0.190	0.330	0.243	0.582	0.055	0.047	0.054	0.209
Wood-Cork	0.029	0.062	0.055	0.070	0.061	0.045	0.050	0.133
Furniture	0.010	0.032	0.031	0.025	0.050	0.044	0.065	0.133
Paper	0.017	0.027	0.385	0.072	0.354	0.414	0.445	0.339
Printing	0.024	0.018	0.019	0.037	0.050	0.051	0.065	0.065
Leather	0.509	0.749	0.817	0.569 *	0.484	0.605	0.638	0.550 *
Plastics-Rubber	0.023	0.047	0.043	0.052	0.154	0.123	0.125	0.162
Chemicals	0.143	0.122	0.137	0.093	0.560	0.473	0.469	0.496
Oil products	0.210	0.214	0.364	0.198	0.266	0.151	0.103	0.105
Non metallic minerals	0.053	0.289	0.269	0.320	0.111	0.115	0.127	0.150
Metallurgy	0.329	0.326	0.293	0.330	0.345	0.318	0.309	0.346
Metal products	0.036	0.135	0.117	0.111	0.277	0.233	0.250	0.274
Machinery	0.004	0.015	0.019	0.031	0.788	0.737	0.744	0.788
Electrical appliances	0.024	0.079	0.088	0.081	0.361	0.402	0.429	0.450
Transport means	0.012	0.056	0.018	0.025	0.562	0.548	0.533	0.531
Various	0.096	0.136	0.088	0.121	0.804	0.732	0.779	0.820
Total	0.101	0.158	0.182	0.185	0.296	0.274	0.258	0.307
Traditional	0.111	0.178	0.210	0.246	0.144	0.137	0.123	0.223
Intermediate	0.118	0.168	0.221	0.153	0.336	0.278	0.251	0.274
Capital	0.079	0.123	0.113	0.123	0.469	0.457	0.444	0.461

* 1981-85.
Source: See Table 1.

tobacco), 166% (wood products), 102% (food industries), 116% (drinks), 105% (furniture), etc. (averages 1981-87 to 1978-80).

On the basis of the above findings it can be concluded that accession

was associated with a simultaneous increase of export intensity (x) and of import penetration (m). Export intensity improved during the 1980's both in relation to the EC and to third countries. However, since m substantially exceeded x, the result was a radical deterioration both in the position of many industries in the domestic market ($d - x$) and in their overall competitive position (d). It is also interesting to note that export intensity improved in the consumer goods industries, which are mainly labour intensive activities. This is an indication that internal factors (especially labour cost) have not affected the export competitiveness of domestic production.

In contrast to the situation in the traditional industries, the deteriorating position of the intermediate goods industries cannot be attributed to accession. Of course, various industries at the three – or four – digit level (e.g. cosmetics, drugs, rubber products etc) have also experienced important import penetration, which is not reflected in the slight increase of the m of the respective two-digit industries in Table 3. However, the overall position of the two-digit intermediate industries appearing in Table 3 is determined by the deterioration in their export performance. This was the result not of integration but of the changes in demand from oil producing Middle Eastern and African countries during the period examined.

The computation of separate indices d for EC and non-member countries suggests quite clearly that the import penetration which determined the deterioration in the competitive position of industry mainly originated in the EC countries. They contributed by approximately 85% to the total absolute change in ($x - m$) during the period 1981-86 while the respective contribution of non-member countries was limited to the remaining 15%.

Attempting to classify industries under the scheme described in part II according to the market share changes observed [14] (not presented in the tables), we can maintain that:

a) double trade creation (an increase in the shares of both the EC and third countries) took place in the branches of drinks, textiles, footwear-apparel, wood-cork, furniture and non-metallic minerals,

b) internal trade creation (increase in the EC share) and external trade diversion (decrease in the share of third countries) was characteristic of the food industries and metallurgy and to a lesser extent also of electrical appliances,

c) double trade erosion (a decrease in the shares of the EC and third countries) took place in leather goods and paper,

[14] Changes equal or below 0.5 percentage point have been considered as indicating stability. An exception was drink industries, because even this small change represented a very high growth rate of penetration in comparison to previous periods.

d) trade creation (an increase of the EC share without changes for third countries) appeared in the cases of tobacco, plastics-rubber and various industries,

e) external trade creation (an increase in the share of third countries with no change for the EC) appeared in the machine industry and in oil products, while

f) some industries do not seem to have been affected by integration (metal products, means of transport, printing and chemicals).

Table 4 presents the basic magnitudes of trade creation as a percentage of the "hypothetical demand", according to different base years (1978, 1979, 1980). For reasons of space, the presentation is limited to the effects on industry as a whole and the three groups of industries for each year between 1981 and 1986. The conclusion to be drawn from these figures is that important trade creation has taken place for the industry as a whole ranging between 6.1% and 20% of the "hypothetical demand" for the EC.

TABLE 4

TRADE EFFECTS TO "HYPOTHETICAL DEMAND" BY GROUPS OF INDUSTRIES AND COUNTRIES *

Anti-monde year	Total industry			Traditional goods		
	EC	Third countries	Greece	EC	Third countries	Greece
1978	6.1	−7.5	−0.7	80.2	13.9	−7.6
1979	11.5	11.1	−3.8	74.0	32.6	−8.0
1980	20.0	−2.0	−4.2	77.2	8.1	−7.2
Anti-monde year	Intermediate goods			Capital goods		
	EC	Third countries	Greece	EC	Third countries	Greece
1978	−11.0	−3.0	3.5	−7.0	−15.1	9.0
1979	0.1	19.0	−1.5	−3.7	−0.3	2.1
1980	4.5	15.2	−2.3	10.4	−10.7	−2.0

* The numbers represent the average of this relation over the period 1981-86, with each *anti-monde* utilised.

SOURCE: See Table 1.

TABLE 5

NET TRADE CREATION (IN MILLION DOLLARS) WITH VARIOUS *ANTI-MONDES* FOR THE POST-ACCESSION YEARS (1981-1986)

Effect for year:	*Anti-monde* year				
	1974	1977	1978	1979	1980
	Total industry				
1981	−230.6	−503.6	−405.0	57.7	104.7
1982	−288.7	−562.5	−463.7	0.5	47.6
1983	− 22.7	−275.9	−184.5	244.6	288.1
1984	−283.2	43.4	130.0	536.3	577.5
1985	496.6	248.2	337.9	759.0	801.7
1986	1216.4	912.0	1021.9	1537.8	1590.1
Total	1454.2	−138.4	436.6	3135.9	3409.7
	Traditional (consumer goods) industries				
1981	247.5	233.8	317.3	351.1	286.8
1982	203.0	189.0	274.4	308.8	243.2
1983	280.0	267.8	342.1	372.0	314.9
1984	370.0	358.0	431.3	460.8	404.5
1985	435.0	422.0	500.0	531.4	471.6
1986	1091.1	1075.4	1171.2	1209.9	1136.2
Total	2626.6	2546.2	3036.3	3234.0	2857.2
	Intermediate industries				
1981	− 66.2	−133.7	−178.4	− 13.8	45.4
1982	−180.4	−245.9	−289.3	−102.9	−72.2
1983	−157.7	−223.6	−267.2	− 79.7	−48.8
1984	63.9	1.6	− 39.7	137.6	166.8
1985	124.9	60.6	18.1	201.0	231.1
1986	120.3	39.5	14.1	216.1	254.0
Total	− 95.2	−501.5	−742.4	385.9	576.3

Source: Own calculations based on National Accounts and Foreign Trade Statistics (see Table 1).

In contrast, third countries appear to be affected by trade diversion if 1978 and 1980 are taken as *anti-mondes* [15].

However, if the effects on industry as a whole permit such contrasting results between the EC and third countries, in traditional industries we can observe quite convergent patterns of behaviour: substantial trade creation for the EC and to a lesser extent for third countries too. For reasons explained previously, the effects on intermediate and capital good industries have to be regarded with caution and cannot be fully ascribed to the influence of integration.

Table 5 gives a translation of the various share-change results into dollar magnitudes. In accordance with the above findings, total trade effects exhibited important variations, ranging from 0.4 billion dollars (with 1978 as base year) to 3.4 billion dollars (1980 as base year).

The different results according to the selection of the *anti-monde* and the methodology, indicate that there is a wide margin of uncertainty about the precise figure of trade effects on Greek industries. However, all the results indicate that trade creation assumed significant dimensions and they permit the estimation of a crude order of magnitude with reasonable confidence [16].

IV. *Analysis of Factors Affecting Imports and Import Penetration*

In this section an attempt will be made to examine the question whether the observed import penetration can be attributed to accession or is the result of other factors. In particular, the question will be examined whether in the years after 1980 a structural break in import penetration can be observed. Of course, it is not possible to associate the presence of structural change exclusively with accession. Obviously, imports are affected not only by changes in protection and integration, but also by changes in other variables of the economic system.

The basic departure is a typical model for the interpretation of imports, in which the variables considered to play some importance are the level of

[15] However, the analytical statistical data (not presented here) show that trade diversion is taking place mainly during the first years of accession (1981-83). After then, and especially in 1985-86, with some exceptions (e.g. steel), there is a shift towards double trade creation. In these years the negative effects grew dramatically and concern the whole industry and not only the traditional activities as before.

[16] It seems us realistic that trade creation in industrial products has taken a magnitude of about 3 to 3.5 billion dollars, which is approximately the amount of total net EC funds to Greece in the same period.

economic activity, prices and protection against imports. To these variables a dummy has been added with the value of zero before and of one after accession.

The hypotheses were tested by means of regression analysis and the regression equations used were based on the following relationships:

$$\left.\begin{matrix} M_i \\ M_i/C \\ M1_i/C_i \end{matrix}\right\} = f(D,\ ACT,\ Pm_i,\ Pd_i,\ T_i)$$

where:

M = Total imports
$M1$ = Imports from EEC
C_i = Apparent consumption for each industry
ACT = Level of economic activity measured alternatively by:
  a) GNP = Gross National Income in constant prices or
  b) Cons = Domestic apparent consumption, which more effectively reflects the pressure of demand on supply
i = Industry
Pm_i = Gross price index of imported goods of industry i
Pd_i = Gross price index of domestic goods sold on the domestic market
T = Changes in the protection level of industry i measured:
  a) T_i = Tariffs, taxes etc./Import value
  b) Annual rate of change of *a*)
D = Dummy variable
  $D = 0$ for pre-accession period (before 1981)
  $D = 1$ for post-accession period (since 1981)
D GNP, D Cons, D Time = Interaction variables

Price variables rarely exhibited a significant relationship to imports or import penetration and in some cases they had the wrong sign [17]. A possible explanation for this behaviour is that prices cannot be expected to exert significant impact on imports of intermediate and capital goods, the majority of which do not compete with domestic production and are not produced in the country. For many consumer goods, the same argument is also valid due to the weak domestic industrial base.

For these reasons we substituted the price variables with the EER (effective exchange rate of the national currency, weighted by the wage

[17] This phenomenon has been noticed in other studies too. See e.g. SELLEKAERTS (1973, p. 539).

price index per unit of manufacturing production). Since changes in prices are supposed to indicate changes in the level of competitiveness of the economy (or industry), the utilisation of the EER can be considered as another proxy reflecting the competitive level of the economy.

Also, as an alternative to the macro-variables (GNP, Consumption), we used a time variable (TIME) with the aim of examining the existence of structural shifts caused after 1981.

Import penetration (total or of EC origin) has been preferred as a dependent variable to imports themselves, because of its advantages. Import penetration is a ratio, which is much less influenced by cyclical variations than imports and is therefore a better indicator for our purpose. The computation of the M/C ratios was based on data on current prices, while in the case of M as a dependent variable, we deflated imports by the gross price index of imported manufactured goods (with the exception of regression 2.9).

It was expected that tariffs would be negatively related to imports. A decrease in the tariff and tax burden on imports should lead to an increase in their volume and in their share of domestic consumption. The EER variable was expected to be positively associated to M and M/C. The increase of this index, which means an overvaluation of the domestic currency, implies a weakening of the international competitiveness of domestic products and should therefore lead to increased imports and import penetration.

There is no a priori argument for the expected signs of the activity variables or for the time variable. For a developing country, as time passes and as production is increased, additional or more diversified forms of domestic production should be expected, at least for specific products (industries). Of course, for various other products the contrary could be assumed.

An econometric investigation of the trade effects in the case of Greece reveals important difficulties. The first reason is that for many products significant non-tariff barriers were applied, which were progressively eliminated in the 1980's, and which exerted a much more important influence on imports than tariff barriers. It is hoped that these effects are captured, at least partially, by the utilisation of dummy variables.

A second difficulty is that before 1981 Greek industry was already exposed to the pressure of import liberalisation as a consequence of the Association Agreement. The regressions which consider 1981 as a benchmark year might not reflect this reality adequately, while on the other hand, for various branches the real integration effects began to be felt after the first two years of accession. The utilisation of the tariff variable is

supposed to indicate the relationship between tariff changes and imports or import penetration over the whole period concerned (1970-1985).

A third problem is of course the relatively small number of observations as well as the number of independent variables, which influence the R^2 in an upward direction.

Equations have been estimated for total industry, the three industry groups and each branch at the two-digit level. All equations were estimated by ordinary least squares. In Tables 6-7 we present the regressions only for those industries for which the dummy or the tariff variable are statistically significant. The period taken into consideration was 1970-85 because some variables (such as EER and prices) were not available for previous or more recent years.

The results presented in Tables 6-7 confirm some of the findings of other studies, such as for instance the great importance of the macro-variables (GNP or consumption) for the level of imports. In all cases the coefficients of these variables are statistically significant at the 5% or 1% level. The same can be said for the time variable. It is interesting that in many industries (or groups of industries) the coefficients of these variables take a negative sign, indicating that in the long-term import penetration tends to decrease, despite an increase in consumption or national production.

The coefficients of the binary variable indicate changes in the intercept of the equation between pre- and post-accession, while the interaction variable allows for shifts in the slope of the regression line. According to the findings, both these variables suggest that in the case of all industry groups and in most individual industries accession has been associated with important changes. We obtained statistically significant coefficients for both the dummy and the interaction variable. It seems therefore that there was a shift in the intercept of the regression line and an increase in the slope of the regression between the pre- and post-accession periods. In particular, there is strong evidence of a reversion of the pre-accession trend in the sense that import penetration, instead of continuing to diminish as before accession, now shows a significant increase.

The coefficients of tariffs (import duties) are also statistically significant, with the expected signs. They indicate that the elimination of tariffs resulted in increased imports and import penetration. As we noticed previously, decreases in import duties occurred throughout the period concerned and the relationship between tariff and import changes is an expression of some more general effects caused by integration into the EC (including association) and not of accession in particular.

The *EER* variable in many equations is not statistically significant.

TABLE 6

EFFECTS OF INTEGRATION TO EC ON INDUSTRY (AGGREGATE LEVEL)

Dependent variable	Industry concerned	Function	Independent variables: C	Dummy	Time	DTime	Cons	DCons	T(ariffs)	EER	R^2	$\bar{R}^2$	DW	F	n
1.1 M/C	Group 1	Lin-Lin	46.19 (6.71)	−34.24 (−3.74) **			−0.040 (−5.33) **	0.091 (4.12) **	−0.244 (−3.60) **	−0.105 (−3.42) **	0.966	0.950	2.50	57.4 **	16
1.2 M/C	Group 1	Ln-Ln	12.36 (3.88)	−25.17 (−4.09) **			−0.746 (−3.16) **	4.218 (4.14) **	−0.474 (−1.82) **	−0.813 (−2.47) *	0.944	0.916	1.54	33.8 **	16
1.3 M1/C	Group 1	Ln-Ln	10.76 (3.03)	−24.68 (−3.59) **			−0.415 (−1.57)^	4.168 (3.66) **	−0.285 (−0.98)	−1.150 (−3.12) **	0.968	0.952	2.06	55.9 **	16
1.4 DME	Group 2	Ln-Ln	14.05 (4.92)	− 0.822 (−1.68)^	0.050 (2.545) *	0.061 (1.548)^			−0.952 (−2.79) **	−0.477 (−1.05)	0.978	0.966	2.00	87.3 **	16
1.5 M1/C	Group 3	Ln-Ln	4.678 (5.34)	− 1.223 (−6.10) **	−0.019 (−5.49) **	0.099 (6.36) **			−0.198 (−3.69) **	−0.115 (−0.608)	0.908	0.862	1.83	19.7 **	16
1.6 DMT	Total industry	Ln-Ln	9.975 (6.37)	−11.55 (−2.28) *			0.495 (4.13) **	1.924 (2.28) *	−0.245 (−2.25) *	−0.379 (−1.74)^	0.946	0.919	1.99	35.1 **	16
1.7 M/C	Total industry	Ln-Ln	6.655 (10.93)	− 0.505 (−3.76) **	−0.023 (−7.45) **	0.047 (4.50) **			−0.187 (−3.34) **	−0.563 (−4.62) **	0.919	0.878	2.33	22.7 *	16
1.8 DME	Total industry	Lin-Lin	34575.7 (3.54)	−67908.2 (−2.97) **			37.78 (3.41) **	168.6 (2.96) **	−97.57 (−2.50) *	−113.2 (−1.81) *	0.950	0.924	2.04	37.7 **	16
1.9 M1/C	Total industry	Ln-Ln	6.988 (9.52)	− 0.534 (−3.30) **	−0.026 (−7.02) **	0.053 (4.18) **			−0.217 (−3.21) **	−0.697 (−4.75) **	0.911	0.867	1.56	20.5 **	16

1. For the industries comprised in each group see note 3 in the text.
2. *DMT* = Total imports deflated by the gross import price index of manufactures.
   DME = Imports from the EC deflated as *DMT*.
3. Significant at the 10%: ^; significant at the 5%: *; significant at the 1%: **; *T*-statistic in parentheses.

TABLE 7

EFFECTS OF INTEGRATION TO EC ON INDUSTRY (SECTORAL LEVEL)

Dependent variable	Branch	Function	Independent variables					
			C	Dummy	Time	GNP	DTime	DGNP
2.1 M/C	Food	Lin-Lin	47.77 (4.96)	−35.09 (−1.85) *				
2.2 M1/C	Food	Lin-Ln	52.77 (2.95)	−173.6 (−2.65) *				
2.3 MT	Textiles	Ln-Ln	− 9.66 (−3.03)	− 55.53 (−5.80) **				
2.4 M/C	Textiles	Ln-Ln	− 3.67 (−1.01)	− 50.51 (−1.83) *		−0.035 (−0.19)	3.992 (1.846) *	
2.5 M1/C	Drinks	Lin-Lin	3.16 (1.34)	− 42.40 (−4.19) **				
2.6 M1/C	Drinks	Lin-Lin	3.408 (2.73)	− 93.18 (−5.91) **				
2.7 DMT	Tobacco	Ln-Ln	−26.44 (−2.41)	− 56.08 (−0.736)		2.744 (3.31) **		4.415 (0.75)
2.8 M1/C	Tobacco	Ln-Ln	−26.56 (−4.25)	− 26.41 (−2.01) *				
2.9 M	Apparel-Footwear	Ln-Ln	−11.50 (−1.33)	− 71.44 (−3.12) **				
2.10 M/C	Apparel-Footwear	Lin-Lin	2.411 (0.233)	− 99.39 (−2.85) **				
2.11 DME	Apparel Footwear	Ln-Ln	1.395 (0.174)	− 69.49 (−3.28) **				
2.12 DME	Apparel-Footwear	Ln-Ln	− 0.757 (−0.163)	− 29.10 (−2.05) *				
2.13 M/C	Wood-Cork	Ln-Ln	16.05 (5.22)	− 23.32 (−2.09) *				
2.14 M1/C	Wood-Cork	Lin-Ln	28.19 (3.27)	−120.0 (−3.84) **				
2.15 M1/C	Furniture	Lin-Lin	2.02 (0.676)	1.119 (1.595) *				
2.16 M/C	Furniture	Lin-Ln	−23.07 (−2.56)	−409.9 (−6.08) **				
2.17 DMT	Rubber-Plastics	Lin-Lin	892.5 (2.09)	−2715.8 (−1.93) *		0.009 (2.29) *		0.0064 (1.964) *
2.18 DMT	Rubber-Plastics	Ln-Ln	1.042 (0.335)	− 45.93 (−2.24) *		0.597 (3.37) **		3.543 (2.24) *
2.19 DMT	Chemicals	Ln-Ln	−16.15 (−5.86)	− 87.79 (−2.20) *		1.983 (9.19) **		6.777 (2.20)

PMD = Gross price index of imported manufactures to gross price index of domestic manufactures produced for the domestic market.
PM = Gross price index of imported manufactures.
MT = Imports, non deflated.
* PM for regression 2.6
** Benchmark year 1980 (instead of 1981) for regression 2.8.

TABLE 7 (*cont.*)

Independent variables					R^2	$\bar{R}^2$	DW	F	n
Cons	DCons	T(ariffs)	EER	PMD *					
−0.074 (−4.99) **	0.095 (2.07) *	−0.341 (−3.28) **	−0.028 (−0.49) **		0.914	0.871	1.67	21.2 **	16
−6.139 (−2.56) *	29.656 (2.71) *	−2.970 (−2.07) *			0.964	0.951	1.29	73.8 **	16
3.135 (12.88) **	9.344 (5.88) **	−0.560 (−1.99) *	0.428 (0.94)		0.996	0.993	2.49	448.3 **	16
		0.329 (1.69)^	−0.481 (−1.524)^		0.913	0.869	2.21	20.91 **	16
0.0073 (−3.09) **	0.106 (4.45) **	−0.013 (−1.44)^	−0.012 (−0.47)		0.966	0.949	1.91	56.6 **	16
0.012 (5.31) **	0.234 (5.90) **	−0.025 (−4.00) **		−0.0076 (−3.14) **	0.982	0.974	2.57	111.9 **	16
		−0.277 (−2.14) *		−0.990 (−5.70) **	0.989	0.983	2.81	178.1 **	16
3.306 (5.07) **	4.650 (2.12) *	0.286 (2.636) *	1.1628 (1.386)^		0.980	0.970	2.20	98.7 **	16
4.162 (6.07) **	11.95 (3.15) **	−2.393 (−2.56) *	0.720 (0.69)		0.990	0.985	1.98	192.1 **	16
0.014 (1.49)^	0.268 (3.15) **	−0.113 (−2.13) *	−0.024 (−0.26)		0.961	0.941	1.83	49.1 **	16
1.030 (1.63)^	11.622 (3.31) **	−1.139 (−1.32)	0.437 (0.45)		0.957	0.936	1.98	44.6 **	16
3.633 (4.41) **	4.864 (2.06) *	−0.979 (−1.723)^		−2.341 (−3.68) **	0.981	0.972	2.15	105.3 **	16
−0.313 (−1.62)^	3.942 (2.12) *	−0.466 (−2.27) *	−2.371 (−4.62) **		0.962	0.944	2.50	51.2 **	16
−0.274 (−0.504)	20.24 (3.89) **	−0.551 (−0.96)	−5.129 (−3.57) **		0.973	0.960	1.75	72.1 **	16
0.0135 (3.92) **	0.0078 (4.41) **	−0.006^ (−0.48)	−0.024 (−0.95)		0.971	0.958	1.31	68.8 **	16
4.866 (3.12) **	69.01 (6.15) **				0.960	0.950	1.91	95.9 **	16
		−11.92 (−2.12) *	−1.069 (−0.49)		0.954	0.931	2.64	41.8 **	16
		−0.600 (−2.20) *			0.948	0.929	2.45	50.3 **	16
					0.942	0.928	1.52	65.1 **	16

This is the case in most of the branch specific regressions. For the broader industry groups (regressions 1.1 to 1.9), *EER* was statistically significant but was always implausible (negative). A possible explanation for this could lie in the inelastic propensity of great parts of the import demand. This finding also indicates the relatively low degree of realism of attempts trying to explain import penetration by stressing exclusively changes in the wage cost which in this case determines the values of *EER*.

In some regressions (2.6, 2.7, 2.12), because of the very poor performance of *EER*, in fact we utilised the price variables, since they proved to be statistically significant and had a negative sign, in accordance with what was expected.

With the exception of regressions 2.1 and 2.4, R^2 varies between 0.942 and 0.996 and *F*-statistics are significant at the 99% confidence level. The poorest results have been obtained for the capital goods sector (1.5), which is reasonable in view of the relatively less pronounced effects of integration on this sector.

V. *Conclusions*

The analysis in the previous sections has shown that accession to the EC was associated with important trade effects for the Greek industrial sector, mainly taking the form of trade creation. Import penetration as a consequence of accession assumed significant dimensions and many Greek industries experienced a continuous erosion of their market shares in the domestic market. The trade effects were sectorally selective since the exposure of industrial activities to world market forces also assumed different dimensions during the period in question.

In the pre-accession period, although tariff protection was gradually eliminated, integration exerted much less intensive effects, perhaps because tariff reduction was not accompanied by similar non-tariff abolition. The radical change in the overall conditions of operation of the economy after 1981 can therefore be seen as causing fundamental changes in the industrial sector. Of course, the results of our analysis should not exclude the possibility of other factors influencing this development. However, they provide strong evidence that the elimination of protection played a particularly important role for the rapid growth of imports.

The negative trends are particularly disturbing because:

a) Accession does not seem to have caused a momentary shift of imports, followed by some kind of stability. Instead, import penetration has

continued to increase and to erode the productive base of the manufacturing sector over the whole period examined.

b) During the years after accession there is a reverse of the previous positive trend towards an increasing weakening of the position of nearly all industrial branches.

c) The branches mostly affected constitute a very important proportion of domestic industrial value added and employment.

d) These branches are among the most experienced and competitive in the domestic productive system (in terms of know-how, long-term experience, knowledge of the market, labour intensive activities, technologically simple production processes etc). Their inability to cope successfully with international competition creates obvious doubts about the possibility of technologically more complex activities becoming established or remaining in the market.

Despite these findings, actually the most strategic issue does not concern the trade effects and the shifts they have caused in market shares during the last years. All these effects can be considered as the cost of adjustment of the Greek economy to conditions of open economy and intensified competition. The critical question concerns the kind of structural effects integration is likely to have on the development perspectives of the country.

In particular, even given the current negative pressures, it could be assumed that at some point the traditional industries would adjust gradually to the new competitive conditions and would enhance their competitive base. The open question is how the production system of the country would be enriched by the creation of new activities (i.e. new for the country) in order to avoid a continuous deterioration of its position in the international (or European) division of labour under conditions of total import liberalisation. The lack of nearly any important investment initiative in a "new" activity during the last 15 years indicate the importance of this factor.

Actually, the most important problem concerning industry in Greece is reflected in its limited capability to initiate a "new development cycle". Restructuring is taking place, but with great difficulties and with results difficult to foresee at this stage. Strategies applied in previous periods (during the 1960's and 1970's) no longer appear to be feasible. Horizontal development has reached its limits and does not ensure competitive advantages for the economy. Direct foreign investment in industry holds no particular interest in the case of a small country, open to imports, with a rather limited technological infrastructure and without a comparative advantage in low wages.

Finally, the continuous erosion of the position of industry in the domestic market implies a loss of its "natural" realm, on which it could depend in order to secure its further development and even its enhancement in the world market. Loss of the domestic market share with unequal offset on the export level, risks to create a vicious circle of reduced sales, reduced productivity and reduced profits. These imply declining investment opportunities which in turn also lead to a deterioration in competitiveness, reduced sales etc.

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INTEGRAZIONE ECONOMICA E SVILUPPO: L'ESPERIENZA DI UNA ECONOMIA DI NUOVA INDUSTRIALIZZAZIONE (GRECIA 1981-1987)

Tema di questo articolo sono gli effetti commerciali sul settore industriale dell'entrata della Grecia nella Comunità Europea sulla base dell'esperienza degli anni 1981-1986. L'articolo esamina i cambiamenti nella protezione tariffaria sia a livello di branca sia in termini di quote di mercato fra produttori nazionali, comunitari e di paesi terzi. Si confronta la posizione concorrenziale delle industrie nei periodi prima e dopo l'entrata e si cerca di calcolare la misura degli effetti sul commercio. Infine, si usa un approccio econometrico per analizzare la relazione fra le variabili macroeconomiche e relative all'entrata nella Comunità, e la penetrazione delle importazioni.

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UNA APPROSSIMAZIONE DELLA VARIABILE CASUALE *G* DI GINI

di
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1. Siano (X_1, Y_1), ..., (X_n, Y_n) n v.c. (variabile casuale) bidimensionali indipendenti e identicamente distribuite generate dalle coppie (x_1, y_1), ..., (x_n, y_n) ottenute con n prove nella v.c. continua (X, Y) con funzione di distribuzione $\phi(x, y)$. Per verificare se fra le marginali di (X, Y) esiste « associazione », Gini (1914) ha proposto un indice che appartiene alla famiglia delle misure di associazione di cui fanno parte, fra le altre, il coefficiente di correlazione di Kendall (1938) ed il coefficiente di correlazione fra ranghi di Spearman (1904). L'indice di Gini, chiamato « coefficiente di cograduazione », è cosí definito:

$$g = (1/D) \sum_{i=1}^{n} \{|r_{xi} - r_{yi}^*| - |r_{xi} - r_{yi}|\}, \qquad (1)$$

dove, nell'ipotesi che fra gli n valori x_i e gli n valori y_i non esistano ripetizioni, r_{xi} e r_{yi} sono i ranghi attribuiti ai valori medesimi, $r_{yi}^* = [(n + 1) - r_{yi}]$, $(i = 1, ..., n)$, mentre:

$$D = n^2/2, \qquad \text{se } n \text{ è pari,}$$
$$D = (n^2 - 1)/2, \qquad \text{se } n \text{ è dispari} \qquad (2)$$

La v.c. G, generata da g al variare della serie di prove in (X, Y), assume valori dell'intervallo $[-1,1]$, e, in particolare i valori:

$$-1 \qquad \text{se e solo se } r_{yi} = (n + 1) - r_{xi},$$

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$$+1 \quad \text{se e solo se } r_{yi} = r_{xi}$$

$$(i = 1, \ldots, n).$$

Ciò premesso sia (X'_1, Y_{j1}), ..., (X'_n, Y_{jn}) un ordinamento della n-upla (X_1, Y_1), ..., (X_n, Y_n) tale che $X'_1 < \ldots < X'_n$, dove $(j_1, \ldots, j_n)$ è una delle $n!$ possibili permutazioni degli interi 1, ..., n.

Nei riguardi della famiglia di misure di cui si è detto vale la seguente assunzione: « in assenza di qualsiasi tipo di associazione fra X ed Y le $n!$ possibili permutazioni dei valori Y_1, ..., Y_n sono fra loro alla pari; in altri termini, le $n!$ possibili n-uple formate da y_1, ..., y_n che può assumere la v.c. (X', Y) hanno ciascuna associata probabilità $1/n!$ ».

Va comunque osservato che, stante un teorema dovuto a W. Hoeffding (1948), se $n \geq 5$ la suddetta assunzione equivale a ritenere le due componenti di (X', Y) fra loro indipendenti in un senso stocastico, ovvero tali che per la funzione di distribuzione della v.c. (X', Y) vale la relazione $\phi'(x', y) = \phi_1(x')\,\phi_2(y)$, essendo $\phi_1(x')$ e $\phi_2(y)$ le funzioni di distribuzione delle marginali di (X', Y).

Ne segue che se $n \geq 5$ i due concetti di « assenza di associazione » e di « indipendenza stocastica » si identificano e, cosí stando le cose, nel seguito si farà sempre riferimento a questo secondo concetto.

Alla v.c. di Gini hanno rivolto la loro attenzione Savorgnan (1915), Amato (1954), Salvemini (1951), Cucconi (1964), Rizzi (1971), Herzel (1972), Cifarelli e Regazzini (1977), Landenna e Scagni (1989).

In particolare, nel caso di indipendenza, Amato ha costruito per $n = 2, 3, \ldots, 7$ la distribuzione della v.c. G mostrando che la medesima è simmetrica rispetto allo zero e quindi che ha tutti i momenti di ordine dispari nulli: $E(G^{2k+1}) = 0$, $(k = 0, 1, \ldots)$.

Inoltre, Amato e Cucconi, indipendentemente uno dall'altro, hanno provato che:

$$E(G^2) = Var(G) = \left\{ \begin{array}{ll} \left[\frac{2}{3(n-1)}\right]\left[1+\frac{2}{n^2}\right] & \textit{per } n \textit{ pari} \quad n > 4; \\ \left[\frac{2}{3(n-1)}\right]\left[1+\frac{4}{n^2-1}\right] & \textit{per } n \textit{ dispari } n > 5. \end{array} \right\} \quad (3)$$

mettendo in evidenza che detta varianza è funzione esclusivamente della numerosità campionaria. Herzel, invece, ha provato che:

$$E(G^4) = \begin{cases} \dfrac{4}{105n^7(n-1)(n-3)}(35n^7 - 111n^6 + 153n^5 - \\ \qquad - 366n^4 + 304n^3 - 456n^2 - 912n + 1248); \\ \dfrac{4}{105(n+1)^3 n(n-1)^4(n-2)}(35n^7 - 76n^6 + 182n^5 \\ \qquad - 307n^4 + 315n^3 - 342n^2 - 420n - 315). \end{cases} \quad (4)$$

e, quindi, che anche il momento quarto è funzione solo di n.

Amato, Cucconi, Salvemini e Herzel, inoltre, hanno osservato come, al divergere di n, la v.c. standardizzata $\tilde{G} = G/[Var(G)]^{1/2}$ converge in distribuzione alla v.c. Normale N (0, 1), mentre Cifarelli e Regazzini ne hanno fornito la dimostrazione rigorosa. Landenna e Scagni hanno identificato una v.c. continua $\hat{G}$, simmetrica rispetto allo zero, la cui varianza coincide con quella della v.c. G, mentre il quarto momento $E(\hat{G}^4)$ approssima rapidamente $E(G^4)$ al divergere di n. In particolare, con una semplice trasformazione, la v.c. G si riduce ad una v.c. di Student rendendo assai agevole la verifica della ipotesi di indipendenza fra le componenti di (X', Y).

Ciò premesso, nella presente nota viene innanzitutto mostrato che la v.c. G di Gini assume determinazioni e probabilità legate direttamente alla numerosità campionaria n. Si propone inoltre una v.c. G^* che, rispetto a quella di Landenna e Scagni, ha il pregio di essere di tipo discreto, in conformità con la natura della v.c. in questione; inoltre assume le stesse determinazioni della v.c. G, ha tutti i momenti dispari nulli e il secondo e quarto uguali a quelli della v.c. G, e il suo comportamento la approssima pressoché perfettamente.

2. Costruite le distribuzioni delle v.c. G per numerosità n da 5 a 12 (Tab. I, prime due colonne), è emerso che, dopo alcune semplici riduzioni, le determinazioni di ciascuna delle v.c. medesime risultano legate alla numerosità campionaria nel modo seguente: se n è pari, si identificano in frazioni il cui denominatore è $w = n^2/4$, mentre i numeratori sono gli interi i da $-w = -(n^2/4)$ a $w = (n^2/4)$ con in piú lo 0; conseguentemente il numero delle determinazioni è $[2(n^2/4) + 1]$.

Cosí, ad esempio, per $n = 6$ la successione delle determinazioni che può assumere la v.c. G è:

$$-\frac{9}{9}, -\frac{8}{9}, \ldots, -\frac{1}{9}, 0, \frac{1}{9}, \ldots, \frac{8}{9}, \frac{9}{9},$$

TABELLA I

n = 5

g_i	p_i	p_i^*	s_i
0.000000	0.150000	0.138984	0.011015
0.166666	0.133333	0.131471	0.001861
0.333333	0.108333	0.115391	- 0.007058
0.500000	0.066666	0.089337	- 0.022671
0.666666	0.075000	0.058005	0.016994
0.833333	0.033333	0.030027	0.003306
1.000000	0.008333	0.011782	- 0.003448

n = 6

g_i	p_i	p_i^*	s_i
0.000000	0.088888	0.099634	- 0.010746
0.111111	0.122222	0.100475	0.021746
0.222222	0.083333	0.095976	- 0.012643
0.333333	0.088888	0.084672	0.004215
0.444444	0.061111	0.067269	- 0.006158
0.555555	0.050000	0.046925	0.003074
0.666666	0.027777	0.028024	- 0.000246
0.777777	0.015277	0.013970	0.001307
0.888888	0.005555	0.005668	- 0.000113
1.000000	0.001388	0.001825	- 0.000436

n = 7

g_i	p_i	p_i^*	s_i
0.000000	0.086507	0.085703	0.000804
0.083333	0.088095	0.085117	0.002977
0.166666	0.080753	0.081760	- 0.001006
0.250000	0.075793	0.075057	0.000735
0.333333	0.063293	0.065072	- 0.001778
0.416666	0.050793	0.052646	- 0.001852
0.500000	0.035515	0.039277	- 0.003761
0.583333	0.027380	0.026701	0.000679
0.666666	0.018650	0.016344	0.002305
0.750000	0.010714	0.008902	0.001812
0.833333	0.004365	0.004262	0.000102
0.916666	0.001190	0.001773	- 0.000583
1.000000	0.000198	0.000633	- 0.000435

n = 8

g_i	p_i	p_i^*	s_i
0.000000	0.072172	0.072115	5.69E-005
0.062500	0.079216	0.071648	0.007567
0.125000	0.064087	0.069550	- 0.005462
0.187500	0.067906	0.065558	0.002347
0.250000	0.057961	0.059641	- 0.001680
0.312500	0.050793	0.052046	- 0.001252
0.375000	0.039384	0.043300	- 0.003915
0.437500	0.033730	0.034135	- 0.000404
0.500000	0.025000	0.025342	- 0.000342
0.562500	0.019047	0.017610	0.001437
0.625000	0.012599	0.011384	0.001214
0.687500	0.007738	0.006804	0.000933
0.750000	0.003943	0.003737	0.000205
0.812500	0.001736	0.001875	- 0.000138
0.875000	0.000595	0.000853	- 0.000258
0.937500	0.000148	0.000350	- 0.000202
1.000000	2.48E-005	0.000129	- 0.000104

TABELLA I

n = 9

g_i	p_i	p_i^*	s_i
0.000000	0.064710	0.062658	0.002051
0.050000	0.063425	0.061999	0.001425
0.100000	0.061337	0.060358	0.000978
0.150000	0.056525	0.057616	- 0.001090
0.200000	0.053408	0.053743	- 0.000334
0.250000	0.047630	0.048820	- 0.001190
0.300000	0.041512	0.043041	- 0.001528
0.350000	0.035471	0.036703	- 0.001231
0.400000	0.029582	0.030169	- 0.000586
0.450000	0.023357	0.023823	- 0.000465
0.500000	0.018160	0.018010	0.000149
0.550000	0.013348	0.012991	0.000357
0.600000	0.009551	0.008910	0.000640
0.650000	0.006481	0.005791	0.000689
0.700000	0.004103	0.003555	0.000548
0.750000	0.002215	0.002054	0.000161
0.800000	0.001025	0.001113	- 8.80E-005
0.850000	0.000374	0.000563	- 0.000189
0.900000	0.000107	0.000266	- 0.000158
0.950000	2.20E-005	0.000116	- 9.45E-005
1.000000	2.75E-006	4.72E-005	- 4.45E-005

n = 10

g_i	p_i	p_i^*	s_i
0.000000	0.054193	0.054317	- 0.000123
0.040000	0.056089	0.053781	0.002307
0.080000	0.052288	0.052606	- 0.000317
0.120000	0.052277	0.050730	0.001546
0.160000	0.047159	0.048136	- 0.000977
0.200000	0.045197	0.044851	0.000346
0.240000	0.039537	0.040954	- 0.001417
0.280000	0.036109	0.036576	- 0.000467
0.320000	0.030740	0.031885	- 0.001145
0.360000	0.026616	0.027078	- 0.000461
0.400000	0.021711	0.022356	- 0.000644
0.440000	0.017761	0.017909	- 0.000148
0.480000	0.013721	0.013893	- 0.000171
0.520000	0.010746	0.010415	0.000331
0.560000	0.007978	0.007530	0.000447
0.600000	0.005819	0.005241	0.000577
0.640000	0.003941	0.003504	0.000437
0.680000	0.002505	0.002246	0.000259
0.720000	0.001439	0.001377	6.21E-005
0.760000	0.000745	0.000806	- 6.07E-005
0.800000	0.000336	0.000450	- 0.000114
0.840000	0.000131	0.000238	- 0.000106
0.880000	4.29E-005	0.000120	- 7.74E-005
0.920000	1.12E-005	5.74E-005	- 4.61E-005
0.960000	2.20E-006	2.59E-005	- 2.37E-005
1.000000	2.75E-007	1.10E-005	- 1.07E-005

dove, per l'appunto, ciascuna frazione ha al denominatore il valore $9 = 6^2/4$, mentre i numeratori sono rappresentati dagli interi da $-9 = -(6^2/4)$ a $9 = (6^2/4)$ con in piú lo 0, essendo $19 = [2\,(6^2/4) + 1]$ il numero delle determinazioni medesime.

Nel caso n dispari vale ancora quanto sopra salvo la sostituzione di $w = n^2/4$ con $w = (n^2 - 1)/4$.

TABELLA I

n = 11

g_i	p_i	p_i^*	s_i
0.000000	0.048362	0.048080	0.000281
0.033333	0.048342	0.047557	0.000785
0.066666	0.047165	0.046607	0.000558
0.100000	0.045731	0.045201	0.000529
0.133333	0.043535	0.043328	0.000207
0.166666	0.041023	0.040998	2.47E-005
0.200000	0.037809	0.038248	- 0.000438
0.233333	0.034654	0.035136	- 0.000481
0.266666	0.031044	0.031744	- 0.000700
0.300000	0.027512	0.028170	- 0.000658
0.333333	0.023918	0.024526	- 0.000607
0.366666	0.020477	0.020922	- 0.000445
0.400000	0.017200	0.017466	- 0.000266
0.433333	0.014169	0.014251	- 8.24E-005
0.466666	0.011419	0.011351	6.75E-005
0.500000	0.009019	0.008815	0.000203
0.533333	0.006943	0.006666	0.000276
0.566666	0.005218	0.004903	0.000314
0.600000	0.003788	0.003503	0.000285
0.633333	0.002668	0.002428	0.000239
0.666666	0.001783	0.001630	0.000152
0.700000	0.001126	0.001059	6.69E-005
0.733333	0.000658	0.000665	- 7.37E-006
0.766666	0.000347	0.000403	- 5.59E-005
0.800000	0.000162	0.000236	- 7.34E-005
0.833333	6.62E-005	0.000132	- 6.67E-005
0.866666	2.29E-005	7.20E-005	- 4.90E-005
0.900000	6.56E-006	3.74E-005	- 3.09E-005
0.933333	1.50E-006	1.87E-005	- 1.71E-005
0.966666	2.50E-007	8.94E-006	- 8.69E-006
1.000000	2.50E-008	4.09E-006	- 4.06E-006

n = 12

g_i	p_i	p_i^*	s_i
0.000000	0.042669	0.042782	- 0.000112
0.027777	0.043170	0.042332	0.000837
0.055555	0.041729	0.041584	0.000145
0.083333	0.041299	0.040521	0.000777
0.111111	0.039171	0.039137	3.39E-005
0.138888	0.037846	0.037437	0.000408
0.166666	0.035105	0.035439	- 0.000334
0.194444	0.033136	0.033173	- 3.78E-005
0.222222	0.030118	0.030681	- 0.000563
0.250000	0.027702	0.028014	- 0.000312
0.277777	0.024621	0.025234	- 0.000613
0.305555	0.022039	0.022404	- 0.000364
0.333333	0.019119	0.019592	- 0.000472
0.361111	0.016660	0.016860	- 0.000200
0.388888	0.014075	0.014268	- 0.000193
0.416666	0.011869	0.011865	4.36E-006
0.444444	0.009717	0.009686	3.06E-005
0.472222	0.007895	0.007757	0.000137
0.500000	0.006236	0.006090	0.000146
0.527777	0.004878	0.004683	0.000195
0.555555	0.003716	0.003524	0.000192
0.583333	0.002787	0.002593	0.000193
0.611111	0.002025	0.001865	0.000160
0.638888	0.001427	0.001309	0.000117
0.666666	0.000958	0.000897	6.15E-005
0.694444	0.000610	0.000599	1.18E-005
0.722222	0.000364	0.000389	- 2.55E-005
0.750000	0.000201	0.000246	- 4.50E-005
0.777777	0.000102	0.000151	- 4.96E-005
0.805555	4.70E-005	9.08E-005	- 4.37E-005
0.833333	1.94E-005	5.27E-005	- 3.33E-005
0.861111	7.07E-006	2.97E-005	- 2.26E-005
0.888888	2.23E-006	1.62E-005	- 1.40E-005
0.916666	5.97E-007	8.59E-006	- 7.99E-006
0.944444	1.29E-007	4.40E-006	- 4.27E-006
0.972222	2.08E-008	2.18E-006	- 2.16E-006
1.000000	2.08E-009	1.04E-006	- 1.04E-006

Cosí, ad esempio, nel caso $n = 7$ la successione delle determinazioni che può assumere la v.c. G è:

$$-\frac{12}{12}, -\frac{11}{12}, \ldots, -\frac{1}{12}, 0, \frac{1}{12}, \ldots, \frac{11}{12}, \frac{12}{12},$$

dove ciascuna frazione ha al denominatore il valore $12 = [(7^2 - 1)/4]$ mentre i numeratori sono rappresentati dagli interi da -12 a $+12$ con in piú lo zero, essendo $25 = \{[2\,(7^2 - 1)/4] + 1\}$ il numero delle determinazioni medesime.

3. Interessa ora individuare la v.c. G^* con le caratteristiche di cui si è detto.

Tale ricerca, tenuto conto della natura simmetrica della v.c. G di Gini, equivale ad identificare per ogni n le probabilità $p_i^* = P(G^* = g^*)$ sotto le condizioni che:

$$i\ )\ p_0^* + 2\sum_{i=1}^{w} p_i^* = p_0 + 2\sum_{i=1}^{w} p_i = 1,$$

$$ii\ )\ 2\sum_{i=1}^{w} (i/w)^2 p_i^* = 2\sum_{i=1}^{w} (i/w)^2 p_i = Var(G),$$

$$iii)\ 2\sum_{i=1}^{w} (i/w)^4 p_i^* = 2\sum_{i=0}^{w} (i/w)^4 p_i = E(G^4),$$

dove i parametri a, b, c, d si ricavano col metodo dei momenti risolvendo il (i/w), $(i = 0, 1, \ldots, w)$.

Ciò premesso si supponga che le probabilità p_i^* siano interpretate dalla seguente funzione esponenziale:

$$p_i^* = e^{a + b(i/w) + c(i/w)^2 + d(i/w)^3}, \tag{5}$$

dove i parametri a, b, c, d si ricavano col metodo dei momenti risolvendo il seguente sistema non lineare nei parametri:

$$\begin{cases} 2\sum_{i=1}^{w} (i/w)^2 p_i = 2\sum_{i=1}^{w} (i/w)^2 p_i^* \\ 2\sum_{i=1}^{w} (i/w)^4 p_i = 2\sum_{i=1}^{w} (i/w)^4 p_i^* \\ p_0 + 2\sum_{i=1}^{w} [(i/w)^2 + 1] p_i = e^a + 2\sum_{i=1}^{w} [(i/w)^2 + 1] p_i^* \\ p_0 + 2\sum_{i=1}^{w} [(i/w)^4 + 1] p_i = e^a + 2\sum_{i=1}^{w} [(i/w)^4 + 1] p_i^* \end{cases} \tag{6}$$

essendo:

$$2 \sum_{i=1}^{w} (i/w)^2 p_i = Var(G),$$

$$2 \sum_{i=1}^{w} (i/w)^4 p_i = E(G^4),$$

$$p_0 + 2 \sum_{i=1}^{w} [(i/w)^2 + 1] p_i = \left(p_0 + 2 \sum_{i=1}^{w} p_i \right) + 2 \sum_{i=1}^{w} (i/w)^2 p_i = 1 + Var(G)$$

$$p_0 + 2 \sum_{i=1}^{w} [(i/w)^4 + 1] p_i = \left(p_0 + 2 \sum_{i=1}^{w} p_i \right) + 2 \sum_{i=1}^{w} (i/w)^4 p_i = 1 + E(G^4)$$

cosicché nell'ordine risultano rispettati i vincoli *ii*), *iii*) ed *i*). In particolare, stante il secondo membro della (5), si ha $p_i^* > 0$, $(i = 0, 1, ..., w)$; inoltre, le equazioni del sistema (6) assicurano che la somma delle probabilità relative a tutte le determinazioni è uguale all'unità, cioè:

$$p_0^* + 2 \sum_{i=1}^{w} p_i^* = e^a + 2 \sum_{i=1}^{w} e^{a + b(i/w) + c(i/w)^2 + d(i/w)^3} = 1.$$

Merita ancora di osservare che i primi membri del sistema (6) sono tutti esprimibili in funzione della numerosità campionaria come emerge, d'altra parte, dalla (3) e dalla (4).

Ovviamente il sistema (6) può essere risolto solo ricorrendo a qualche metodo di ottimizzazione numerica quale, ad esempio, quello di Gauss-Newton.

Ricorrendo, per l'appunto, a tale metodo si sono ottenuti i valori dei parametri *a*, *b*, *c*, *d* della funzione (5) per numerosità campionarie *n* da 5 a 12 riportati nelle prime otto righe della Tabella II. Tramite tali valori si sono poi costruite le distribuzioni delle v.c. G^* approssimanti le corrispondenti v.c. G di Gini.

Il grado di approssimazione di G^* a G è stato misurato tramite la somma dei quadrati degli scarti tra valori osservati e valori attesi (Efron, 1978):

$$l^2 = \sum_{i=0}^{w} (p_i - p_i^*)^2 \qquad (7)$$

e tramite il seguente indice (Frosini, 1987):

$$I^2 = 1 - \frac{\sum_{i=0}^{w} (p_i - p_i^*)^2}{\sum_{i=0}^{w} (p_i - \bar{p})^2} \tag{8}$$

dove $\bar{p} = [1/(w+1)] \sum_{i=0}^{w} p_i$.

In particolare, dalla stessa Tabella II (ultime due colonne) emerge che I^2 è sempre pressoché nullo e I^2 assume sempre valori elevatissimi e, comunque, mai inferiori a 0.98.

Nella Tabella I (terza e quarta colonna), sempre per n compreso fra 5 e 12, sono proposti anche i valori delle probabilità p_i^* calcolate in base alla (5) e degli scarti $s_i = (p_i - p_i^*)$, scarti che, come si osserva, sono pressoché trascurabili.

TABELLA II

	a	b	c	d	I^2	I^2
5	-1.97339	-0.209834	-0.438205	-1.819741	1.49E-015	0.984
6	-2.30624	0.243792	-1.171983	-3.071553	4.58E-016	0.981
7	-2.45686	0.070388	-1.545587	-3.432281	3.28E-015	0.998
8	-2.62948	0.049337	-2.190171	-4.183367	7.27E-015	0.999
9	-2.77006	-0.071341	-2.570616	-4.547327	5.20E-015	0.998
10	-2.91291	-0.111621	-3.188954	-5.200442	9.31E-016	0.997
11	-3.03487	-0.202385	-3.592225	-5.576558	3.26E-014	0.998
12	-3.15163	-0.258832	-4.197821	-6.164027	4.55E-015	0.998
20	-4.50586	-0.973122	-0.651973	-1.793312	1.75E-014	0.999
25	-4.81916	-1.124245	-1.04880	-2.239166	1.20E-015	0.999

4. I risultati conseguiti inducono a ritenere che, qualunque sia n, tramite la soluzione del sistema (6), la funzione (5) possa consentire di pervenire, alla v.c. G^* la cui distribuzione è un'ottima approssimazione della v.c. G di Gini.

Poiché la costruzione della v.c. di Gini per numerosità $n > 12$ si presenta laboriosissima anche col ricorso ad un elaboratore, si può ricordare che, sulla base dei risultati conseguiti da Cifarelli e Regazzini, per $n \geq 20$ la distribuzione della v.c. medesima, debitamente standardizzata, può ritenersi Normale. Approfittando di tale fatto, pertanto, si sono costruite le distribuzioni della v.c. G di Gini e delle v.c. G^* approssimanti la stessa nei casi

TABELLA III
n = 20

g_i	p_i	p_i^*	s_i
0.00000	0.010165	0.011044	0.000879
0.01000	0.010165	0.010936	0.000771
0.02000	0.010158	0.010828	0.000669
0.03000	0.010145	0.010719	0.000574
0.04000	0.010125	0.010610	0.000484
0.05000	0.010099	0.010500	0.000400
0.06000	0.010066	0.010389	0.000322
0.07000	0.010027	0.010278	0.000250
0.08000	0.009981	0.010165	0.000183
0.09000	0.009930	0.010052	0.000121
0.10000	0.009872	0.009937	6.48E-005
0.11000	0.009808	0.009821	1.32E-005
0.12000	0.009738	0.009704	-3.35E-005
0.13000	0.009662	0.009587	-7.56E-005
0.14000	0.009581	0.009468	-0.000113
0.15000	0.009495	0.009348	-0.000146
0.16000	0.009402	0.009227	-0.000175
0.17000	0.009305	0.009104	-0.000200
0.18000	0.009203	0.008981	-0.000222
0.19000	0.009096	0.008856	-0.000240
0.20000	0.008985	0.008730	-0.000254
0.21000	0.008869	0.008603	-0.000265
0.22000	0.008749	0.008475	-0.000273
0.23000	0.008625	0.008345	-0.000279
0.24000	0.008497	0.008215	-0.000281
0.25000	0.008365	0.008083	-0.000282
0.26000	0.008231	0.007950	-0.000280
0.27000	0.008093	0.007817	-0.000276
0.28000	0.007952	0.007682	-0.000270
0.29000	0.007809	0.007546	-0.000262
0.30000	0.007663	0.007410	-0.000253
0.31000	0.007515	0.007272	-0.000242
0.32000	0.007366	0.007134	-0.000231
0.33000	0.007214	0.006995	-0.000218
0.34000	0.007061	0.006856	-0.000205
0.35000	0.006907	0.006716	-0.000191
0.36000	0.006752	0.006575	-0.000176
0.37000	0.006596	0.006435	-0.000161
0.38000	0.006439	0.006293	-0.000145
0.39000	0.006282	0.006152	-0.000130
0.40000	0.006125	0.006010	-0.000114
0.41000	0.005968	0.005869	-9.93E-005
0.42000	0.005811	0.005727	-8.40E-005
0.43000	0.005655	0.005586	-6.90E-005
0.44000	0.005499	0.005445	-5.44E-005
0.45000	0.005344	0.005304	-4.03E-005
0.46000	0.005190	0.005164	-2.66E-005
0.47000	0.005038	0.005024	-1.36E-005
0.48000	0.004886	0.004885	-1.26E-006
0.49000	0.004736	0.004747	1.04E-005

$n = 20$ ed $n = 25$ (Tabella III, prime tre colonne) e si sono calcolati gli scarti $s_i = (p_i - p_i^*)$ (Tabella III, ultima colonna). In particolare, nelle ultime due righe della Tabella II figurano i valori dei parametri a, b, c, d e degli indici I^2 e I^2.

I risultati conseguiti assicurano che il grado di approssimazione risulta ancora piú elevato ($I^2 \approx 0$; $I^2 \approx 0.999$; scarti s_i pressoché trascurabili), e un tale fatto dà conforto sulla bontà della v.c. G^*.

TABELLA III
n = 20

g_i	p_i	p_i^*	s_i	g_i	p_i	p_i^*	s_i
0.50000	0.004588	0.004609	2.13E-005	0.76000	0.001597	0.001646	4.88E-005
0.51000	0.004441	0.004473	3.15E-005	0.77000	0.001520	0.001564	4.36E-005
0.52000	0.004297	0.004338	4.09E-005	0.78000	0.001446	0.001484	3.82E-005
0.53000	0.004154	0.004203	4.94E-005	0.79000	0.001374	0.001407	3.29E-005
0.54000	0.004013	0.004071	5.71E-005	0.80000	0.001306	0.001333	2.75E-005
0.55000	0.003875	0.003939	6.40E-005	0.81000	0.001240	0.001262	2.21E-005
0.56000	0.003739	0.003809	7.00E-005	0.82000	0.001176	0.001193	1.68E-005
0.57000	0.003606	0.003681	7.52E-005	0.83000	0.001115	0.001127	1.16E-005
0.58000	0.003475	0.003554	7.95E-005	0.84000	0.001057	0.001063	6.47E-006
0.59000	0.003346	0.003429	8.31E-005	0.85000	0.001000	0.001002	1.48E-006
0.60000	0.003220	0.003306	8.58E-005	0.86000	0.000947	0.000943	-3.33E-006
0.61000	0.003097	0.003185	8.78E-005	0.87000	0.000895	0.000887	-7.98E-006
0.62000	0.002977	0.003066	8.90E-005	0.88000	0.000846	0.000834	-1.24E-005
0.63000	0.002860	0.002949	8.95E-005	0.89000	0.000799	0.000782	-1.66E-005
0.64000	0.002745	0.002834	8.93E-005	0.90000	0.000754	0.000733	-2.06E-005
0.65000	0.002633	0.002722	8.85E-005	0.91000	0.000711	0.000687	-2.44E-005
0.66000	0.002524	0.002611	8.70E-005	0.92000	0.000670	0.000642	-2.79E-005
0.67000	0.002418	0.002503	8.50E-005	0.93000	0.000632	0.000600	-3.12E-005
0.68000	0.002315	0.002398	8.25E-005	0.94000	0.000594	0.000560	-3.42E-005
0.69000	0.002215	0.002295	7.95E-005	0.95000	0.000559	0.000522	-3.69E-005
0.70000	0.002118	0.002194	7.61E-005	0.96000	0.000526	0.000486	-3.94E-005
0.71000	0.002024	0.002096	7.22E-005	0.97000	0.000494	0.000452	-4.16E-005
0.72000	0.001933	0.002001	6.81E-005	0.98000	0.000464	0.000420	-4.35E-005
0.73000	0.001845	0.001908	6.36E-005	0.99000	0.000435	0.000390	-4.52E-005
0.74000	0.001759	0.001818	5.89E-005	1.00000	0.000408	0.000361	-4.66E-005
0.75000	0.001677	0.001731	5.39E-005				

TABELLA III
n = 25

g_i	p_i	p_i^*	s_i
0.000000	0.007376	0.008073	0.000697
0.006410	0.007376	0.008015	0.000639
0.012821	0.007373	0.007956	0.000583
0.019231	0.007368	0.007897	0.000529
0.025641	0.007360	0.007838	0.000477
0.032051	0.007350	0.007778	0.000427
0.038462	0.007338	0.007718	0.000380
0.044872	0.007323	0.007658	0.000335
0.051282	0.007305	0.007597	0.000292
0.057692	0.007285	0.007536	0.000251
0.064103	0.007263	0.007475	0.000212
0.070513	0.007238	0.007413	0.000174
0.076923	0.007211	0.007351	0.000139
0.083333	0.007181	0.007288	0.000106
0.089744	0.007150	0.007225	7.55E-005
0.096154	0.007115	0.007162	4.61E-005
0.10256	0.007079	0.007098	1.86E-005
0.10897	0.007040	0.007033	-7.14E-006
0.11538	0.007000	0.006969	-3.11E-005
0.12179	0.006957	0.006903	-5.34E-005
0.12821	0.006912	0.006838	-7.41E-005
0.13462	0.006865	0.006771	-9.31E-005
0.14103	0.006815	0.006705	-0.000110
0.14744	0.006764	0.006638	-0.000126
0.15385	0.006711	0.006570	-0.000140
0.16026	0.006657	0.006503	-0.000153
0.16667	0.006600	0.006434	-0.000165
0.17308	0.006542	0.006366	-0.000175
0.17949	0.006481	0.006297	-0.000184
0.18590	0.006420	0.006227	-0.000192
0.19231	0.006358	0.006157	-0.000199
0.19872	0.006291	0.006087	-0.000204
0.20513	0.006225	0.006016	-0.000209
0.21154	0.006157	0.005945	-0.000212
0.21795	0.006088	0.005874	-0.000214
0.22436	0.006018	0.005802	-0.000215
0.23077	0.005946	0.005730	-0.000216
0.23718	0.005874	0.005658	0.000216
0.24359	0.005800	0.005585	-0.000214
0.25000	0.005725	0.005512	-0.000213
0.25641	0.005649	0.005439	-0.000210
0.26282	0.005572	0.005365	-0.000207
0.26923	0.005495	0.005292	-0.000203
0.27564	0.005416	0.005218	-0.000198
0.28205	0.005337	0.005143	-0.000193
0.28846	0.005258	0.005069	-0.000188
0.29487	0.005177	0.004995	-0.000182
0.30128	0.005097	0.004920	-0.000176
0.30769	0.005015	0.004846	-0.000169
0.31410	0.004934	0.004771	-0.000163
0.32051	0.004852	0.004696	-0.000155
0.32692	0.004770	0.004621	-0.000148
0.33333	0.004687	0.004546	-0.000140
0.33974	0.004605	0.004471	-0.000133
0.34615	0.004522	0.004396	-0.000125
0.35256	0.004439	0.004322	-0.000117
0.35897	0.004356	0.004247	-0.000109
0.36538	0.004274	0.004172	-0.000101
0.37179	0.004191	0.004098	-9.35E-005
0.37821	0.004109	0.004023	-8.56E-005
0.38462	0.004027	0.003949	-7.77E-005
0.39103	0.003945	0.003875	-6.98E-005
0.39744	0.003864	0.003802	-6.21E-005
0.40385	0.003783	0.003728	-5.45E-005
0.41026	0.003702	0.003655	-4.70E-005
0.41667	0.003622	0.003582	-3.98E-005
0.42308	0.003542	0.003510	-3.26E-005
0.42949	0.003463	0.003438	-2.57E-005
0.43590	0.003385	0.003366	-1.90E-005
0.44231	0.003307	0.003294	-1.26E-005
0.44872	0.003230	0.003224	-6.37E-006
0.45513	0.003154	0.003153	-3.83E-007
0.46154	0.003078	0.003083	5.34E-006
0.46795	0.003003	0.003014	1.08E-005
0.47436	0.002929	0.002945	1.60E-005
0.48077	0.002856	0.002877	2.09E-005
0.48718	0.002784	0.002809	2.55E-005
0.49359	0.002712	0.002742	2.99E-005

TABELLA III
n = 25

g_i	p_i	p_i^*	s_i	g_i	p_i	p_i^*	s_i
0.50000	0.002642	0.002676	3.39E-005	0.75641	0.000696	0.000718	2.17E-005
0.50641	0.002572	0.002610	3.77E-005	0.76282	0.000668	0.000688	1.95E-005
0.51282	0.002504	0.002545	4.12E-005	0.76923	0.000642	0.000659	1.73E-005
0.51923	0.002436	0.002480	4.44E-005	0.77564	0.000616	0.000631	1.52E-005
0.52564	0.002370	0.002417	4.73E-005	0.78205	0.000591	0.000604	1.31E-005
0.53205	0.002304	0.002354	4.99E-005	0.78846	0.000567	0.000578	1.11E-005
0.53846	0.002240	0.002292	5.23E-005	0.79487	0.000543	0.000553	9.11E-006
0.54487	0.002176	0.002231	5.43E-005	0.80128	0.000521	0.000528	7.16E-006
0.55128	0.002114	0.002170	5.61E-005	0.80769	0.000499	0.000504	5.27E-006
0.55769	0.002053	0.002110	5.77E-005	0.81410	0.000478	0.000481	3.43E-006
0.56410	0.001992	0.002051	5.89E-005	0.82051	0.000458	0.000459	1.65E-006
0.57051	0.001933	0.001993	6.00E-005	0.82692	0.000438	0.000438	-6.10E-008
0.57692	0.001875	0.001936	6.07E-005	0.83333	0.000419	0.000417	-1.70E-006
0.58333	0.001819	0.001880	6.13E-005	0.83974	0.000401	0.000398	-3.28E-006
0.58974	0.001763	0.001824	6.16E-005	0.84615	0.000383	0.000379	-4.79E-006
0.59615	0.001708	0.001770	6.17E-005	0.85256	0.000366	0.000360	-6.23E-006
0.60256	0.001655	0.001716	6.16E-005	0.85897	0.000350	0.000342	-7.60E-006
0.60897	0.001602	0.001664	6.13E-005	0.86538	0.000334	0.000325	-8.89E-006
0.61538	0.001551	0.001612	6.07E-005	0.87179	0.000319	0.000309	-1.01E-005
0.62179	0.001501	0.001561	6.01E-005	0.87821	0.000305	0.000293	-1.12E-005
0.62821	0.001452	0.001511	5.92E-005	0.88462	0.000291	0.000278	-1.23E-005
0.63462	0.001404	0.001462	5.82E-005	0.89103	0.000277	0.000264	-1.33E-005
0.64103	0.001357	0.001415	5.70E-005	0.89744	0.000264	0.000250	-1.42E-005
0.64744	0.001312	0.001368	5.57E-005	0.90385	0.000252	0.000237	-1.51E-005
0.65385	0.001267	0.001322	5.43E-005	0.91026	0.000240	0.000224	-1.58E-005
0.66026	0.001224	0.001277	5.27E-005	0.91667	0.000229	0.000212	-1.66E-005
0.66667	0.001182	0.001233	5.11E-005	0.92308	0.000218	0.000201	-1.72E-005
0.67308	0.001140	0.001190	4.93E-005	0.92949	0.000207	0.000190	-1.78E-005
0.67949	0.001100	0.001147	4.74E-005	0.93590	0.000197	0.000179	-1.83E-005
0.68590	0.001061	0.001106	4.55E-005	0.94231	0.000188	0.000169	-1.87E-005
0.69231	0.001023	0.001066	4.35E-005	0.94872	0.000178	0.000159	-1.91E-005
0.69872	0.000986	0.001027	4.14E-005	0.95513	0.000170	0.000150	-1.95E-005
0.70513	0.000950	0.000989	3.93E-005	0.96154	0.000161	0.000141	-1.97E-005
0.71154	0.000914	0.000952	3.72E-005	0.96795	0.000153	0.000133	-2.00E-005
0.71795	0.000880	0.000915	3.50E-005	0.97436	0.000145	0.000125	-2.01E-005
0.72436	0.000847	0.000880	3.28E-005	0.98077	0.000138	0.000118	-2.02E-005
0.73077	0.000815	0.000846	3.06E-005	0.98718	0.000131	0.000111	-2.03E-005
0.73718	0.000784	0.000812	2.84E-005	0.99359	0.000124	0.000104	-2.03E-005
0.74359	0.000754	0.000780	2.61E-005	1.00000	0.000118	9.79E-005	-2.03E-005

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